THIRTY-FOURTH ANNUAL REPORT

OF THE

Ontario Agricultural College

AND

Experimental Farm

1908

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.)

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To the Honourable JOHN MORISON GIBSON, K.C., LL.D., etc., etc., etc.,
Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned begs to present for the consideration of Your Honour, the Report of the Ontario Agricultural College and Experimental Farm for 1908.

Respectfully submitted,

JAMES S. DUFF,
Minister of Agriculture.

THE ONTARIO AGRICULTURAL COLLEGE, GUELPH, ONT.

HON. JAMES S. DUFF, *Minister of Agriculture, Toronto, On*

FACULTY OF INSTRUCTION, 1909.

G. C. CREELMAN, B.S.A., M.S. .... President.
H. H. DEAN, B.S.A. .... Professor of Dairy Husbandry.
C. A. ZAVITZ, B.S.A. .... Professor of Field Husbandry.
J. HUGO REED, V.S. .... Professor of Veterinary Science.
H. L. HUTT, B.S.A. .... Professor of Landscape Gardening.
G. E. DAY, B.S.A. .... Professor of Animal Husbandry.
J. B. REYNOLDS, B.A. .... Professor of English.
R. HARCOURT, B.S.A. .... Professor of Chemistry.
JOHN EVANS .... Professor of Manual Training.
S. B. McCREADY, B.A. .... Professor of Botany and Nature Study.
S. F. EDWARDS, M.Sc. .... Professor of Bacteriology.
C. J. S. BETHUNE, M.A., D.C.L. .... Professor of Entomology.
W. R. GRAHAM, B.S.A. .... Professor of Poultry Husbandry.
W. P. GAMBLE, B.S.A. .... Professor of Chemistry.
W. H. DAY, B.A. .... Professor of Physics.
E. J. ZAVITZ, B.A., M.S.F. .... Professor of Forestry.
MORLEY PETTIT .... Lecturer in Apiculture.
T. D. JARVIS, B.S.A. .... Lecturer in Entomology.
JOHN BUCHANAN, B.S.A. .... Lecturer in Field Husbandry.
J. W. CROW, B.S.A. .... Lecturer in Horticulture.
R. W. WADE, B.S.A. .... Lecturer in Animal Husbandry.
D. H. JONES, B.S.A. .... Lecturer in Bacteriology.
H. H. LEDREW, B.S.A. .... Lecturer in Economics.
W. HUNT .... Lecturer in Floriculture.
J. W. EASTHAM, B.S. .... Lecturer in Botany.
J. E. HOWITT, M.S.A. .... Lecturer in Botany and Entomology.
H. L. FULMER, B.S.A. .... Demonstrator in Chemistry.
LAWSON CAESAR, B.S.A. .... Demonstrator in Fungus Diseases and Insects.
Miss M. A. PURDY .... Demonstrator in Chemistry.
J. R. TERRY .... Demonstrator in Poultry Husbandry.
EDITH C. DWIGHT, B.A. .... Teacher in French and German and Assistant Librarian.
G. M. FRIER, B.S.A. .... Dean of Residence and Instructor in English.
E. W. KENDALL .... Instructor in Manual Training.
M. F. COGLAN, B.S.A. .... Fellow in Chemistry.
W. R. REEDS .... Teacher in Drill and Gymnastics.

Macdonald Institute.

Miss M. U. WATSON .... Director of Home Economics.
ANNIE ROSS, M.D. .... Lecturer in Physiology and Home Nursing.
Miss HELEN GIVEN .... Instructor in Domestic Science.
Miss GRACE GREENWOOD .... Instructor in Normal Methods.
Miss ROSEMINA GREIST .... Instructor in Domestic Art.
Miss EDNA FERGUSON .... Assistant Instructor in Domestic Science.
Miss EVELYN ALLAN .... Instructor in Laundry and Household Administration.
Miss ETHEL FONDA .... Assistant Instructor in Domestic Art.
Captain CLARK .... Teacher in Drill and Gymnastics.

Other Officers.

S. SPRINGER .... Bursar and Superintendent.
J. B. FAIRBAIRN .... Secretary.
Mrs. FULLER .... Superintendent Macdonald Hall.
Mrs. CUNNINGHAM .... Matron Agricultural College.
Dr. W. O. STEWART .... Physician.

ONTARIO AGRICULTURAL COLLEGE

AND EXPERIMENTAL FARM.

To the Honorable the Minister of Agriculture:

SIR,—I have the honor to submit herewith the thirty-fourth annual report of the Ontario Agricultural College and Experimental Farm, including the report of the Macdonald Institute, for the year 1908.

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Ontario Agricultural College.

PART I.

THE PRESIDENT.

Again we have to record a larger attendance than ever before in any one year. From the 1st of January, 1908, until the 31st of December of the same year, there were 1,225 separate and distinct students who received more or less instruction in one or more of our departments. This means that the classes have been larger and the work of the professors, lecturers, demonstrators, and other officers very much increased. We believe that better work is being done every year, and we are well pleased with the progress made by the students during the past twelve months.

CHANGES IN THE STAFF.

I am pleased to record, also, that during the past year there have been fewer changes than usual in the College staff. Many of our men have been offered better positions elsewhere, but for family reasons or for patriotic reasons, or both, they have seen fit to remain with us, and we are distinctly the gainers thereby.

The following changes have taken place during the year:

In the department of Bacteriology, Mr. B. Barlow, who has been with us so many years, on account of ill health resigned his position as lecturer and returned to his home in Michigan. We regret the loss of Mr. Barlow, as he was one of our strong scientific men, an indefatigable worker, and a first-class botanist, as well as bacteriologist. Mr. D. H. Jones, of last year's graduating class, was appointed to succeed Mr. Barlow in the department of Bacteriology.

A new position was created, known as Specialist in Plant Diseases. This was filled by the appointment of Mr. L. Caesar, one of our matured students and an old teacher; also a member of last year's graduating class. Mr. Caesar has been attached to the department of Entomology and Zoology and is investigating and offering remedies for plant diseases and insect ravages in field and orchard throughout the Province of Ontario.

Mr. R. R. Graham, who so efficiently filled the position of Resident-Master for one year, resigned at the beginning of the session to go back into his fourth year. He was succeeded by Mr. G. M. Frier, of last year's graduating class. I am pleased to say that Mr. Frier is giving excellent satisfaction in the College Residence.

HOME ECONOMICS.

Again the work of the Macdonald Institute is meeting with favor throughout the length and breadth of this land, and applications are also coming in and some students are being admitted from other countries.

Macdonald Hall has been filled to its utmost capacity, and although more than thirty girls are completing their work and leaving the Hall at Christmas time, every room has been taken for the new term commencing January 5, and we have had to refuse a number of applications for rooms.

COLLEGE WORK AND PROGRESS.

As will be seen from the report of the Dean of Residence, the boys' dormitory was again filled, every bed being taken and seventy-two regular students, in addition, being obliged to board outside. We shall, at a very early date, be obliged to make arrangements for further residence space for students.

The bulletins prepared during the year by members of the College Staff and published by the Department of Agriculture are as follows:

162. "Breakfast Foods: Their Chemical Composition, Digestibility, and Cost," by R. Harcourt and H. L. Fulmer.

163. "Incubation of Chickens," by W. R. Graham, W. H. Day, C. C. Thom, R. Harcourt, and H. L. Fulmer.

164. "Legume Bacteria," by S. F. Edwards and B. Barlow.

165. "Alfalfa or Lucerne," by C. A. Zavitz.

168. "The Perennial Sow Thistle and Some Other Weed Pests," by J. E. Howitt.

SHORT COURSES.

These courses continue very popular. Even the Short Course in Horticulture, provided in January of this year for the first time, was well attended and much enthusiasm was shown in the work. The attendance at these Courses was as follows: Dairy Courses, 42; Two Weeks' Course in Stock and Seed Judging, 328; Two Weeks' Course in Horticulture, 78; Four Weeks' Course in Poultry Raising, 19; One-month Course in Domestic Science, 12; One-month course in Elementary Agriculture and Nature Study, 49; One-month course in Manual Training, 18.

STOCK JUDGING.

Greater interest each year is being taken in the judging of live stock. This has been stimulated by student competition at our own Winter Fair in Guelph and intercollegiate competition at the International Live Stock Exposition in the city of Chicago. At the Winter Fair more than ninety students competed this year, with the result shown in another column. The team that visited Chicago this year were also well trained but were not successful in taking any of the prizes. At this show the competition is growing keener each year, the men of other colleges are being better trained, and perhaps the wonder is that our students won three times in succession, 1905, 1906, and 1907, rather than that we should not stand first in 1908.

EXCURSIONS.

The month of June was again devoted to Farmers' Institute excursions, and large numbers came from the different parts of the Province and systematically visited the different departments of the College and Farm. The College also entertained the members of many organizations, directly or indirectly interested in the work, and during the year the following associations visited us:

Feb. 19—Legislative Assembly of Ontario.
March 7—Canadian Press Association.
May 29—Waterloo and Berlin Teachers' Association.
June 4 and 5—Victoria Teachers' Association.
June 8—Galt High School Children.

June 13—Lincoln Teachers' Association.
June 17—S. Brant Rural School Children.
June 22—Durham Teachers' Association.
Aug. 26—Scottish Agricultural Commission.
Oct. 31—Canadian Manufacturers' Association.
Nov. 5 and 6—Canadian Entomological Society.

WOMEN'S INSTITUTES.

The organization known as the Women's Institute has become an important factor in rural education. Their annual convention is held at this College, and on December 9 and 10 this year some 800 ladies attended the daily sessions, to listen to the papers read and to take part in the discussions which followed. Miss Van Rensselaer, of Cornell University, Mr. C. C. James, Deputy Minister of Agriculture for Ontario, and Dr. Helen MacMurchy, of Toronto, were the principal speakers from outside the membership of the association.

EXPERIMENTAL UNION.

As usual, a large number of ex-students returned to the meeting of the Experimental Union held December 7 and 8. Mr. M. A. Carleton, Cerealist of the Department of Agriculture at Washington, D.C., was the principal speaker brought from outside Ontario, and his instructive talks were appreciated by our people.

On the evening of the 8th of December, at the College Boys' Supper we had the pleasure of entertaining as the guest of the College that distinguished journalist, Mr. J. S. Willison, Editor of the "News," Toronto. Mr. Willison delivered an admirable address to the 500 persons who sat down to supper, representing student, staff, and graduating body.

It is a question in my mind as to whether the work of the Union receives at the time of its annual meeting, the attention it deserves. There is possibly no more important agricultural organization in Ontario, and yet, owing to the fact that we are obliged to begin on Monday, and because the principal days of the Winter Fair come during the same week, it seems impossible to secure at the Union such an attendance as the excellent work of the association should warrant. It is a question whether some other week of the year should not be selected, perhaps at the time of the holding of our short courses in January. At that time there are from 200 to 500 farmers in attendance, and they, together with the students in our regular classes and those in dairying and poultry raising, would insure the officers of the Experimental Union a large attendance of persons interested in their work.

GRADUATES AND OTHER EX-STUDENTS.

The question is often asked, Do your College boys go back to the Farm? I am pleased to be able to say that the great majority of them do. Since one of the conditions of entrance was made to include at least one year's tuition on a farm we have been admitting from year to year a larger number of practical men who, having tried farming and found it good, have made up their minds to stick to it as life work. Their College Course to them is only a more thorough preparation for farm life and work.

In all classes at the College during the past twelve months we have had 781 men students, most of whom have returned or will return directly to Ontario farms. There are, however, some men each year who, because they

have no farms of their own, or because younger brothers have come on to take their places, or for some other reasons, desire to prepare themselves for professional work in agriculture. Such men complete their four years and take their degree from Toronto University. In last year's graduating class there were thirty, and the following is a list of the positions secured by some of them since graduation:

Archibald, E. S., Lecturer in Animal Husbandry, Agricultural College, Truro, N.S.

Arkell, T. R., Agricultural Editor, "Citizen" Ottawa, Ont.

Atkin, J. P., Agricultural Editor, "Journal," Ottawa, Ont.

Barnet, W. A., Tobacco Specialist, Department of Agriculture, Ottawa.

Bowes, L. A., Agricultural Editor, "Telegram," Winnipeg, Man.

Brown, W. A., Professor of Poultry Husbandry, State Agricultural College, Orono, Maine.

Caesar, L., Specialist in Plant Diseases, Ontario Agricultural College.

Curran, G. B., Editor, "Farm Crops," Winnipeg, Man.

Denniss, F. H., Assistant, Dairy Department, Knoxville, Tenn.

Frier, G. M., Resident-Master, Ontario Agricultural College, Guelph.

Gilmour, J. D., Assistant, Dominion Department of Forestry, Ottawa.

Groh, H., Assistant Entomologist, Central Experimental Farm, Ottawa.

Hare, J. H., Agricultural Specialist for County of Ontario, Whitby.

Hibberd, G., Assistant Agronomist, Agricultural College, Maryland.

Hodson, R. W., Assistant Live Stock Commissioner, Victoria, B.C.

Jones, D. H., Lecturer in Bacteriology, Ontario Agricultural College.

Jull, M. A., Assistant, Experiment Station, West Virginia.

Lewis, E., Assistant to Agricultural Specialist, Essex, Ont.

MacKenzie, D. A., Agricultural Specialist for County of Victoria, Lindsay, Ont.

Murray, C., Director of Agriculture for Newfoundland.

Owen, W. C., Assistant to Agricultural Specialist, Morrisburg, Ont.

Slater, A. E., Science Teacher, Trinity College School, Port Hope, Ont.

Warren, F. B., Assistant to Agricultural Specialist, Galt, Ont.

Winslow, R. M., Agricultural Specialist for Prince Edward County, Picton, Ont.

Students in Household Science at Macdonald Institute.

In a general way the same conditions prevail in our Women's Department. The great majority of our students come from farm or village homes and returning there directly they have completed their course, assist or take charge of the house work. There are others, however, more matured women, who come to us for special preparation to enable them to teach domestic science in our schools. Others take our Professional Housekeeper Course, which is a preparation for the domestic management of large institutions.

The large number of girls returning to their homes in this Province, after receiving practical instruction in shorter or longer courses at Macdonald Institute, must in time materially affect the home life throughout the Province, especially in rural communities.

The following named graduates of Macdonald Institute are now located in positions as follows:—

Miss Bligh—Household Science teacher in Edmonton, Alta.

Miss Bray—Employed by Ontario Provincial Secretary's Department in Hospital for the Insane.

Miss Carlyle—Domestic Science teacher in Brockville public schools.

Miss Davis—Supervisor of sewing, public schools Vancouver, B.C.
Miss Dutcher—Household Science teacher in Prince of Wales College, Charlottetown, P.E.I.
Miss Elliott—Household Science teacher, Normal School, Hamilton.
Miss Gardner—Hospital Dietitian, Columbus, Ohio, U.S.
Miss McDunnough—Housekeeper in Y. W. C. A., Kingston, Ontario.
Miss Jean McKenzie—Housekeeper, Reading Hospital, Reading, Pa.
Miss Mary McLennan—Domestic Science teacher, Albany Guild, Albany, N.Y., U.S.
Miss McManus—Assistant in flour testing Department, Ogilvie Milling Company, Montreal, Que.
Miss Macmillan—Temporary assistant, Macdonald Institute, O.A.C.
Miss Mortimer—Housekeeper, Macdonald College, Que.
Miss Murdoch—Dietitian, Beaver Valley General Hospital, New Brighton, Pa., U.S.
Miss Northrup—Domestic Science teacher in public schools, St. John, N.B.
Miss Powell—Dietitian, St. Barnabas Hospital, Minneapolis, Minn., U.S.
Miss J. D. Ross—Domestic Science teacher, Alma College, St. Thomas.
Miss Steinhoff—Household Science teacher, Normal School, Peterboro.
Miss Warner—Housekeeper, Victoria Hospital, London, Ont.

Buildings Erected During 1908.

A new coal-house, to hold 3,000 tons of coal, has been completed.

A brick house, for the storing of fruit and vegetables, is also finished and occupied.

A large addition to the Engineer's Department has given room for the new boilers, which are now installed.

In connection with the Horticultural Department two new cottages have been built which accommodate the florist and the foreman of the garden.

At the Poultry Department a splendid brick building has been erected for the accommodation of incubators. This has been much needed, as this branch of the work is of very great importance to the poultry raisers of the Province.

The Horticultural Department.

For some years the Professor of Horticulture has been asking that the department be divided and separate work allotted to different heads. Last year the Minister of Agriculture saw fit to make this division, and Prof. Hutt selected as his part of the work Landscape Gardening. The Professor now finds time to give assistance, where requested, to rural schools and civic improvement generally throughout the Province, mainly through the provincial horticultural societies.

The work in Horticulture proper is now under the direction of Mr. J. W. Crow, Lecturer in Horticulture, who has as his assistant in the work, Mr. A. McMeans, who is a specialist in the growing of vegetables. Mr. Hunt remains as College Florist and lectures on Floriculture to the young men in the College classes, as well as to the young ladies in attendance at Macdonald Institute.

OUTSIDE LECTURES.

A number of excellent lectures were delivered before the members of our student body in Massey Hall at regular intervals during the year. These lectures proved very interesting and instructive, and we are obliged to the following gentlemen for the assistance which they have rendered to us:

Dr. A. H. Abbott, Toronto, Ont.—"Color Sensations;" "Some Recent Investigations into Thought Processes."

Prof. C. A. Chant, Toronto, Ont.—"The Universe of the Stars."

Prof. John Dearness, London, Ont.—"The Field and Method of Nature Study."

Mr. W. D. Hobson, Woodstock, Ont.—"Our Common Birds and Their Songs."

Mr. W. E. Saunders, London, Ont.—"Birds: Their Lives and Habits."

Prof. J. Squair, Toronto, Ont.—"French Painting."

Mr. Frank Yeigh, Toronto, Ont.—"Canada."

AGRICULTURE IN OUR HIGH SCHOOLS.

As reported last year, six young men were appointed to the work of as many counties in Ontario as specialists, representing the Ontario Department of Agriculture. This work has met with unbounded success. Short courses have been inaugurated; special institutes have been held; experimental plots have been grown; articles have been written for the agricultural and local press; farmers' clubs have been formed; and other agricultural activities have been entered into with zest and enthusiasm.

In June of this year two other counties were provided with specialists, Mr. J. H. Hare, B.S.A., going to Ontario county and being located at Whitby, and Mr. R. M. Winslow, B.S.A., to Prince Edward county, and located at Picton.

During the year I inspected the six original schools, my report being published by the Department of Education.

STUDENTS OF THE YEAR.

ATTENDANCE.

General Course	40	
Specialists in General Course Work	13	
Manual Training	18	
Dairy Courses	42	
Short Courses in Stock and Seed Judging	328	
Short Course in Poultry Raising	19	
Short Course in Horticulture	78	
		902

AT MACDONALD INSTITUTE.

Domestic Science	274	
Nature Study and Elementary Agriculture	49	
		323
Total		1,225

There were also 140 children from the Guelph Public Schools who received instruction in Domestic Science at Macdonald Institute.

Analysis of College Roll (General Course), 1908.

From Ontario.

Algoma	1	Nipissing	1
Brant	11	Norfolk	3
Bruce	4	Northumberland	4
Carleton	5	Ontario	10
Dufferin	1	Oxford	14
Dundas	4	Parry Sound	1
Elgin	3	Peel	3
Essex	4	Perth	5
Frontenac	3	Peterboro	3
Glengarry	1	Prescott	1
Grenville	5	Prince Edward	1
Grey	7	Rainy River	2
Haldimand	8	Renfrew	1
Halton	10	Russell	3
Hastings	8	Simcoe	9
Huron	5	Stormont	1
Kent	3	Victoria	4
Lambton	7	Waterloo	12
Lanark	3	Welland	6
Leeds	1	Wellington	25
Lennox	2	Wentworth	11
Lincoln	7	York	27
Middlesex	11		
Muskoka	3	Total for Ontario	264

From other Provinces of the Dominion.

Alberta	3	P. E. Island	2
British Columbia	16	Quebec	5
Manitoba	3	Saskatchewan	8
New Brunswick	3		
Nova Scotia	11	Total for other Provinces	51

From other Countries.

Argentine Republic	4	Jamaica	4
Belgium	1	Mexico	1
Cape Breton	1	New Zealand	2
East Indies	1	Scotland	8
England	21	South Africa	8
Germany	1	Spain	4
Holland	1	U. S. A.	22
Ireland	3	Wales	2
India	2		
Japan	3	Total for other Countries	89

Ages and Religious Denominations.

The limits of age of students in the General Course, 1908, ranged from 16 to 39 years. The average age was 20.

Presbyterian	124	Friends	3
Methodist	103	United Brethren	3
Episcopalian	87	Hinduism	2
Baptist	34	Mennonite	2
Roman Catholic	20	Quaker	2
Congregational	7	Unitarian	2
Christadelphian	4	Disciple	1
No Religion	4	Evang. Assoc.	1
Dutch Reform	3		

Bachelors of the Science of Agriculture, 1908.

Archibald, E. S., Wolfville, N.S.
Arkell, T. Reg., Arkell, Ont.
Barnet, W. A., Living Springs, Ont.
Bowes, L. A., Strathnairn, Ont.
Brown, W. A., Meaford, Ont.
Caesar, L., Mono Road, Ont.
Clowes, F. A., Toronto, Ont.
Curran, G. B., Orillia, Ont.
Denniss, F. H., London, Ont.
Frier, G. M., Shediac, N. B.
Gilmour, J. D., Doe Lake, Ont.
Groh, H., Preston, Ont.
Hare, J. H., Cobourg, Ont.
Hibberd, G., New Windsor, Md.
Hodson, R. W., Toronto, Ont.
Johnson, D. M., London, Ont.
Jones, D. H., Guelph, Ont.
Jull, M. A., Burford, Ont.
Lewis, E., Westbrook Mills, N. S.
MacKenzie, D. A., Queenhill, Ont.
McLennan, A. H., Trafalgar, Ont.
Metcalf, I. F., Burford, Ont.
Murray, Chas., Avening, Ont.
Owen, W. C., Thornton, Ont.
Patch, A. M. W., Torquay, Eng.
Slater, A. E., Lunbridge, Wales.
Rose, D. M., London, Eng.
Warren, F., Gamebridge, Ont.
Winslow, R. M., Chelsea Green, Ont.
Wolverton, H. A., Nelson, B. C.

Recipients of Associate Diploma, 1908.

Aldwinckle, E. H., London, Eng.
Armstrong, P. P., Jermyn, Ont.
Arnold, J. H., Eastons Corners, Ont.
Augustine, H. W., Burnaby, Ont.
Ballantyne, N. M., Stratford, Ont.
Beaupre, F. C., Simcoe, Ont.
Bowes, L. A., Strathnairn, Ont.
Bowman, W., Georgetown, Ont.
R. N. Bray, Nashville, Ont.
Brown, E. N., Pineville, Penn., U. S. A.
Campbell, J. A., Lawrence Station, Ont.
Campbell, A. D., Strathroy, Ont.
Canby, F., Burnaby, Ont.
Christie, H. R., Amherst, N. S.
Collins, G. W., O. A. C. Guelph, Ont.
Faulds, T. B., Marmora, Ont.
Ferguson, Chas., Eversley, Ont.
Foster, K. A., Abernethy, Sask.
Foster, N., Toronto, Ont.
Fraser, Roy, Galetta, Ont.
French, P. E., Vernon, B. C.
Guillet, H. J., Mille Roches, Ont.
Haight, W. L., Conway, Ont.
Hibberd, G., New Windsor, Md.
Johnson, D. M., London, Ont.
Kennedy, S., Applehill, Ont.
Kerr, Wm., Bronson, Ont.
King, J. H., Smiths Creek, N. B.
Kitchen, E., St George, Ont.
Knauss, H. L., Detroit, Mich.
Knopf, A. E., Montreal, Que.
Lawson, E. V., Dunlop, Ont.
LeLacheur, G., Murray Harb. S., P.E.I.
Learmonth, C., Galetta, Ont.
Lewis, J. M., Knoxville, Ill., U. S. A.
Lloyd-Jones, J. G., Llandinan, Wales.
Middleton, W. A., Vernon, B. C.
Moorhouse, R. L., Cairo, Ont.
Neville, S. J., Cottonwood, Sask.
Newhall, H. W., Toledo, Ohio, U. S. A.
Packard, R. C., Brockton, Mass., U. S. A.
Petrie, C. M., Guelph, Ont.
Pritchard, T. W., Redgrave, Ont.
Reek, W. R., Romney, Ont.
Revell, H. K., Walkerville, Ont.
Robertson, C. L., Rancho de Miraflores, Mexico.
Robertson, W. H., Barrington Passage, N. S.
Robinson, E., Guelph, Ont.
Shaw, A. M., Niagara Falls South, Ont.
Slater, J. A., Galt, Ont.
Smith, A. S., Chesterville, Ont.
Snyder, A. S., Blair, Ont.
Todd, S. E., Jordan Harbour, Ont.
Tothill, J. D., Bungay, Eng.
Turney, A. G., Saventhen, Belgium
Walker, R. A., Caledonia, Ont.
Wearne, H., Rixheim, Germany.
Whetham, C. A., Kirkwall, Ont.
White, O. C., Ashburn, Ont.
Wilson, S., Rolling Dam, N. B.
Young, W. H., Mirvin, Sask.

First Class Men.

The work of the College is divided into departments, and all candidates [w]ho obtain an aggregate of seventy-five per cent. of the marks allotted to [th]e subjects in any department, are ranked as first class men in that depart[me]nt. The following list contains the names of those who gained a first [cla]ss rank in the different departments, at the examinations held in April, [19]08, arranged alphabetically:

First Year.

Baker, A. C., in three departments, English and Mathematics; Chemistry and Physics; Biology.

Bradt, E., in one department, Biology.

Clement, F. M., in three departments, English and Mathematics; Chemistry and Physics; Biology.

Coglon, R. B., in one department, Chemistry and Physics.

Cohoe, D. P., in two departments, English and Mathematics; Biology.

Emmerson, W. W., in one department, Chemistry and Physics.

Ewing, A. A., in one department, Biology.

Fisher, P. A., in one department, Biology.

Gandier, S. H., in three departments, English and Mathematics; Chemistry and Physics; Biology.

Howard, C. F., in one department, Chemistry and Physics.

King, V., in one department, Biology.

Martindale, F. R., in one department, Chemistry and Physics.

Strong, W. J., in three departments, English and Mathematics; Chemistry and Physics; Biology.

Toole, A. A., in two departments, Chemistry and Physics; Biology.

Toole, W., in one department, Biology.

Second Year.

Aldwinckle, E. H., in three departments, English; Chemistry and Physics; Agriculture.

Christie, H. R., in one department, English.

LeLacheur, G., in four departments, English; Chemistry and Physics; Biology; Agriculture.

Reek, W. R., in one department, Chemistry and Physics.

Wilson, S., in one department, Chemistry and Physics.

SCHOLARSHIPS.

Scholarships of $20 each in money were awarded for groups of subjects in first year work as follows: Highest standing with a minimum of forty per cent. of the marks for each subject, and an aggregate of seventy-five per cent. of the total number of marks allotted to the subjects in the group:

English and Mathematics, W. J. Strong, Hatfield, Essex, Eng.
Chemistry and Physics, S. H. Gandier, Lion's Head, Ont.
Biology, A. C. Baker, London, Ont.

THE GEORGE CHAPMAN SCHOLARSHIP.

A prize of $20 in books awarded on the work in English of the first two years. The three divisions of the work under the English Department are taken into consideration in awarding the prize, namely, English Literature, English Composition, and Public Speaking. Winner in 1908: E. H. Aldwinckle, London, England.

PRIZES.

Three prizes of the value of $10 each in books, were awarded as follows:

One to the second year student who composed and read before a committee the best essay on the subject assigned for the year, viz., "Reading in the Farm Home." Winner: Mr. G. LeLacheur, Murray Harbour South, P.E.I.

One to the student who stood first in general proficiency on first and second year work—Theory and practice.—G. LeLacheur.

One to the student who ranked highest in general proficiency and obtained first-class honors in his major subjects in the fourth year. Winner: Mr. D. H. Jones, O.A.C., Guelph, Ont.

In February last the Louden Machinery Company of Guelph generously offered a cash prize of $20 for the best drawn plan of a barn. The competition was open to students of the second year, and the only stipulation was that the plan should not be large or elaborate, but that the accommodation should be sufficient for about twenty cattle and six horses.

This prize was divided between Messrs. W. R. Reek and A. A. Snyder, each receiving $10.

Medals.

Governor-General's Silver Medal: First in General Proficiency, First and Second Year work, 1907-1908. Winner: G. LeLacheur, Murray Harbour South, P.E.I.

Barton-Hamer Gold Medal: Awarded to that member of the O.A.C. International Live Stock Judging Team, securing the highest number of marks in the Student's Judging Contest, held annually at Chicago. Winner: R. W. Hodson, Toronto, Ont.

The 1905 Gold Medal: Awarded to the member of the Senior Year who, during his course, has done the most for the College, for his fellow-student, and for himself. Winner: R. M. Winslow, Chelsea Green, Ont.

Cash Prizes Won at Guelph Winter Fair.

On Friday, December 11, at the Guelph Winter Fair, a judging competition in Live Stock was held for young men twenty-five years of age and under. The competitions were in charge of Prof. G. E. Day, W. W. Ballantyne, Robert Miller, and J. E. Brethour. Sixty per cent. of the points was given for placing forty per cent. for reasons. The O.A.C. students who won in the various classes are as follows:—Beef Cattle: First, R. J. Allan; second, S. Kennedy; third, W. N. Campbell; fourth, A. D. Campbell; fifth, M. S. Middleton; sixth, A. McMillan; seventh, R. G. Thomson; eighth, A. M. Shaw; ninth, A. McTaggart; tenth, W. R. Reek.

Dairy Cattle: First, R. B. Coglon; second, R. Schuyler; third, C. M. Learmonth; fourth, G. S. Dunkin; fifth, A. McTaggart; sixth, S. H. Culp; seventh, C. Rebsch; eighth, M. M. Baldwin; ninth, C. L. S. Palmer; tenth, R. H. Pilsworth.

Sheep: First, Outsider; second, S. Kennedy; third, W. H. Irvine, fourth, J. F. Harries; fifth, J. E. Rettie; sixth, C. Main; seventh, R. G. Thomson; eighth, Outsider; ninth, J. C. Young; tenth, Outsider.

Swine: First, J. S. Howell; second, W. H. Irvine; third, M. McArthur; fourth, Outsider; fifth, W. G. Orvis; sixth, F. Forsyth; seventh, W. Toole; eighth, A. J. Cowie; ninth, R. R. Moore; tenth, M. M. Baldwin.

Financial Statement.

I append the Financial Statement prepared by Mr. S. Springer, Bursar.

I have the honour to be,

Your obedient servant,

Guelph, December 31, 1908. G. C. CREELMAN.

NANCIAL STATEMENT, 1908.

COLLEGE DEPARTMENT.

EXPENDITURE.

Salaries and wages	$57,626 27
Servants' paylist (including laundryman)	3,201 74
Meat, bread, groceries, laundry, engine room supplies and fuel	30,768 71
Advertising, printing, postage and stationery	3,788 83
Maintenance, five laboratories	3,915 41
Expenses, Short Courses	1,188 35
Temporary assistance	522 39
Student labor	4,504 87
Travelling expenses and extra lectures	1,999 97
Library	1,606 23
Scholarships	80 00
Telephone service, rents, etc.	395 50
Furnishings and repairs	3,942 81
Sewage	496 80
Contingencies	1,246 92
Services and expenses of temporary assistants in connection with Farm Drainage Demonstrations	999 97
Total Expenditure	$116,284 77
Less Revenue	28,567 64
Net Expenditure	$87,717 13

REVENUE.

Board	$20,022 65
Tuition and laboratory fees	7,323 00
Supplemental examinations	99 00
Chemical analyses	203 92
Rent of cottages	240 00
Rent of rooms	130 90
Rent of Post Office boxes	40 25
Fines and breakages	463 69
Sundries	44 23
Total Revenue	$28,567 64

STUDENT LABOR, 1908.

Total per Month.

January	$570 44
February	461 26
March	393 26
April	108 20
May	205 12
June	372 91
July	265 48
August	279 15
September	465 45
October	673 27
November and December	710 33
	$4,504 87

To Different Departments.

College Department	$278 30
Macdonald Institute	31 78
Chemical Laboratory	96 58
Bacteriological	32 44
Entomological	125 48
Physical	74 50
Botanical	109 08
Library	19 06
Nature Study	24 18
Farm Department	1,103 25
Experimental	985 09
Poultry	464 47
Horticultural	666 46
Dairy Department	31 69
Mechanical	462 51
	$4,504 87

MACDONALD INSTITUTE AND HALL.

Expenditure.

Salaries and wages	$15,040 00
Servants' pay list	1,793 82
Bread, meat, groceries, furnishings, repairs, engine room supplies and fuel, and labor on grounds	12,805 52
Maintenance of laboratories in Institute	2,886 81
Library and stationery	790 47
Total Expenditure	$33,316 62
Less Revenue	18,548 13
Net Expenditure	$14,768 49

Revenue.

Board	$13,132 75
Tuition and laboratory fees	5,239 50
Supplemental examinations	10 00
Fines and breakages	139 23
Sale of supplies to Nature Study students	26 65
Total Revenue	$18,548 13

FARM DEPARTMENT.

Expenditure.

Permanent improvements	$ 490 00
Wages of men, foreman and stenographer	6,455 16
Purchase of live stock	5,806 22
Maintenance of stock	2,915 99
Farm maintenance (including repairs, blacksmithing, binder twine, seed, furnishings, fuel, light, advertising, printing, stationery, tools, implements, etc.)	2,392 26
Contingencies	296 90
Total Expenditure	$18,356 53
Less Revenue	6,017 95
Net Expenditure	$12,338 58

N.B.—Nothing allowed the Farm Department for the feed, etc., of the department horses, and supplies for the College and Macdonald Hall, including milk.

Revenue.

Sale of cattle:—		
24 steers, 31,477 lbs., at from $5.25 to $8.00	$1,824 98	
1 steer for	40 00	
5 cows for	210 00	
1 heifer for	30 00	
3 bulls for	285 00	
11 calves for	310 50	
		$2,700 48
Sale of pigs:—		
166 hogs at from $5.00 to $6.60	$1,973 55	
4 sows for	82 85	
		2,056 40
Sale of sheep:—		
2 rams at $15	$30 00	
3 ewes at $6	18 00	
1 lamb	5 50	
		53 50

REVENUE.—*Continued.*

Service of animals		65 00
Sale of wool, 414 lbs. at from 7c. to 9c.		37 16
" 3 old wagons for		9 00
" 1 bag potatoes for		1 50
" 1 calf skin, 50c.; 1 sheep skin, 90c.		1 40
" 87 bags at 25c.		21 75
Sale of grain:—		
5 bush. wheat at $1.25	$ 6 25	
205¼ bush. barley at 85c.	174 68	
24 bush. oats at 55c.	13 20	
		194 13
Sale of milk:—		
8,450 qts. milk at 4c.	$338 00	
4,346.88 lbs. fat at from 10.5c. to 33.33c.	539 63	
		877 63
Total Revenue		$6,017 95

EXPERIMENTAL DEPARTMENT.

EXPENDITURE.

Permanent improvements	$ 498 98
Assistant, specialist in plant breeding, stenographer, foreman, teamsters and laborers	8,328 23
Seeds, manure and special fertilizers	596 97
Furnishings, implements, repairs (blacksmithing, etc.)	632 66
Printing, postage, stationery, contingencies, etc.	315 29
Total Expenditure	$10,372 13

DAIRY DEPARTMENT.

EXPENDITURE.

Permanent improvements	$ 109 72
Wages, including foreman, cheesemaker, buttermaker, engineer, stenographer and bookkeeper	2,446 00
Hauling and manufacturing milk into butter and cheese	1,890 97
Furniture, furnishings, repairs, etc., laboratory expenses, gas, chemicals, etc., and contingencies	769 68
Fuel and light	380 17
Assistant official tester of dairy cattle	437 50
Total Expenditure	$6,034 04
Less Revenue	3,950 51
Net Expenditure	$2,083 53

REVENUE.

Sale of butter, 3,133 lbs. at from 20c. to 35c.		$991 02
" cheese, 562½ lbs. at from 5c. to 13c.		57 52
" cream, 717½ qts. at from 20c. to 40c.		163 50
" fat, 147.84 lbs. at from 11.2 to 31.5		36 62
" skim-milk, 5,909 lbs. at 15c.		8 86
" buttermilk, 117,900 lbs. at from 10c. to 25c. cwt.		121 35
" whey		25 76
" sundries		3 20
Refund of express charges		1 85
Rent of house		120 00
Manufacturing butter:—		
8,657.29 lbs. at 3c.	$ 259 72	
48,633.59 lbs. at 4c.	1,945 35	
		2,205 07
Manufacturing cheese:—		
2,603.51 lbs. at 1c.	$26 03	
12,649.52 lbs. at 1½c.	189 73	
		215 76
		$3,950 51

DAIRY SCHOOL.

Expenditure.

Permanent improvements, cement floors, walks, etc.	$ 169 57
Wages of instructors, engineer, janitor, stenographer and bookkeeper	1,900 00
Cleaning, painting, repairs and contingencies	169 80
Dairy appliances, separators, vats, expense cheese and butter judges, inspecting factories, etc.	465 65
Advertising, printing, stationery, postage, books, papers, etc.	150 91
Fuel and light	188 16
Purchase of milk for use in school	5,203 46
Total Expenditure	$8,247 55
Less Revenue	5,555 55
Net Expenditure	$2,692 00

Revenue.

Fees	$62 00
Breakages	4 05
Sale of butter, 12,960 lbs at from 20c. to 35c.	4,145 73
" cheese, 9,047½ lbs. at from 6c. to 15c.	1,147 67
" cream, 690 qts. at from 20c. to 40c.	155 85
" buttermilk, 3,500 lbs. at 25c. cwt.	8 75
" whey	20 00
" sundries, milk tests, $1.50, two old churns $10.00	11 50
Total Revenue	$5,555 55

POULTRY DEPARTMENT.

Expenditure.

Wages of assistant, stenographer and temporary assistance	$ 856 50
Furnishings and repairs	1,079 88
Permanent improvements	100 00
Purchase of stock	192 10
Fuel, light and contingencies	320 02
Experiments with incubator, fattening and feed	2,321 35
Total Expenditure	$4,869 85
Less Revenue	1,628 30
Net Expenditure	$3,241 55

Revenue.

Sale of eggs for hatching:—		
130½ settings at from 75c. to $3.00	$163 00	
1,914 eggs at 5c.	95 70	
		$258 70
Sale of eggs for domestic use:—		
1,963 1-12 doz. at from 10c. to 40c.		437 94
Sale of live poultry, 183 birds, at from $1.00 to $10.00		254 00
Sale of dressed poultry:—		
3,899 15-16 lbs. at from 8c. to 18c.	$467 07	
7 chickens at 50c.	3 50	
162 broilers at from 35c. to 75c.	77 50	
204 ducks at from 50c. to 60c.	110 59	
60 squabs at 25c.	15 00	
		673 66
Sale of 16 lbs. duck feathers at 25c.		4 00
Total Revenue		$1,628 30

HORTICULTURAL DEPARTMENT.

Expenditure.

Permanent improvements	$398 79
Head gardener and foreman, assistant in plant breeding, assistant and night firemen, teamsters, assistant gardener, stenographer and laborers	6,167 82
Manure, trees, plants, bulbs, seeds, cold storage, experiments, implements, tools, furnishings, repairs and contingencies	1,602 98
Fuel and light	914 54
Wax fruit models	502 75
Total Expenditure	$9,586 88
Less Revenue	38 18
Net Expenditure	$9,548 70

Note:—Products supplied to College except when more than required.

Revenue.

Sale of parsley	$ 9 27
Sale of onions	21 37
Sale of cucumbers	5 54
Sale of 1 load wood	2 00
Total Revenue	$38 18

MECHANICAL DEPARTMENT.

Expenditure.

Salary of foreman	$800 00
Tools, fuel and light	199 11
Total Expenditure	$999 11

FORESTRY DEPARTMENT.

Expenditure.

Expenses in Forestry	$9,496 26

SUMMARY, 1908.

	Expenditure.	Revenue.	Net Expenditure.
College Department	$116,284 77	$28,567 64	$87,717 13
Macdonald Institute and Hall Department	3,316 62	18,548 13	14,768 49
Farm Department	18,356 53	6,017 95	12,338 58
Experimental Department	10,372 13	....	10,372 13
Dairy Department	6,034 04	3,950 51	2,083 53
Dairy School Department	8,247 55	5,555 55	2,692 00
Poultry Department	4,869 85	1,628 30	3,241 55
Horticultural Department	9,586 88	38 18	9,548 70
Mechanical Department	999 11	....	999 11
Forestry Department	9,496 26	....	9,496 26
Totals	$217,563 74	$64,306 26	$153,257 48

S. Springer,
Bursar and Superintendent.

PART II.

THE PROFESSOR OF ENGLISH.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit herewith my fourteenth annual report in the department of English.

At present the courses remain much as they were, and I have only to report, in a general way, continued progress in the classes through all the branches of instruction in the department.

Of the branches of instruction in this department,—English Literature, Composition, and Public Speaking,—the two former are receiving their due share of attention. As is inevitable with three distinct branches, the greatest attention has been paid to that branch which offers the least resistance or the greatest attraction. The study of literature is the most attractive of the three; it can be carried on almost as effectively with a large class as with a small one, and as it makes less positive demand on the time of the student, it suits better with a crowded programme of studies. In such conditions, the study of literature is not likely to suffer comparatively, nor have I been disposed to slight it, for its cultural and inspirational value is high.

Composition has not fared quite so well, though it has been by no means neglected. Every sensible student realizes the value to him of being able to write well, but the practice of composition merely for the sake of writing a composition is often irksome, and the duty liable to be evaded. Then as the numbers in the classes increase, the task laid upon the instructors increases proportionately, and from this cause a further limit is imposed upon the amount of work possible in composition. For this year the freshman classes in composition are taught by Mr. Frier, Dean of Residence, and the Sophomore and Junior Classes by Mr. Le Drew, Lecturer in Economics. Neither of these men can give undivided attention to English Composition. Yet the work of this branch is not at present suffering, and there has been marked improvement in the compositions of these classes, both in style and thought. I wish here to commend the painstaking ability of both Mr. Frier and Mr. Le Drew in conducting their respective classes so effectively.

It is in the third branch that the chief lack is felt. To effect results worth while, public-speaking classes should be held continuously and frequently, in the Sophomore and Junior years at least, under a competent instructor who is sufficiently free from other work to give the proper attention to instruction and criticism. So much do the students, the senior students especially, feel the need of further practice and instruction in this branch, that they have attempted, twice within my knowledge, to make private contracts with instructors from the outside. It may be asked,—what do they expect to gain by any such instruction? In the main, it may be said that they seek, not to become elocutionists, or orators, but they seek to become, as far as in them lies, good extempore speakers.

Last September, it was my privilege to visit the Iowa State College at Ames, Iowa. While there, I made special inquiry into the organization of their English department, so far as it concerns the students of the Agricultural Faculty. I found these three departments separately organized: a department of Literature and Rhetoric, with a professor, an assistant pro-

fessor, and a number of assistants; a department of Public Speaking, with a professor and two assistants; and a department of Agricultural Journalism, with one lecturer. I attended a number of their classes to study methods of teaching, particularly in Public Speaking; and besides having conferences with the present professor and instructors, I was enabled to meet the recent head of the department of Public Speaking, Professor Newens, who had lately been appointed as critic of the Lyceum in Chicago.

Allow me to quote a paragraph from the Iowa State College Calendar for 1908-09. This will show what is being done elsewhere in this direction, and also will set forth what we aim to do here:

"The courses in Extempore Speech are designed to give students practical training in speaking without notes or without having written and committed to memory a formal address. There is a great demand for men who are well versed in the sciences and industries as offered in the several departments of the College, to address institutes, conventions, clubs, and commissions on topics related to their chosen work. At gatherings formal and informal that person is in demand who can say the right thing at the right time and in the right way. It is a worthy accomplishment to be able to speak well upon any occasion. For all such, these courses aim to prepare the student. They are in every way practical. The student from the very first is called to the floor to address his class on assigned topics. He is given from three days to a week to gather his material and get it ready for his appearance before the class. As often as once a week each individual is on the floor, oftener if possible. He is subjected to criticisms by the class and the instructor. Criticisms are offered on the prescribed lines of general appearance, force of address, arrangement of material, use of words, vocabulary, etc., etc. By subjecting himself to this severe scrutiny, and by the frequency of his addresses, the student gains an acquaintance with himself and a habit of thinking on his feet, which is real experience in speech-making, second only to that which he would gain in appearing before outside audiences."

I strongly urge that an instructor be appointed, competent to take charge of the Public Speaking classes, and to assist in the other branches of the English department.

The additions in English to the Library have been, as heretofore, both liberal and well chosen. I am pleased to report that, so far as I can judge from the evidences in class, the students seem to be making good use of the Library.

Respectfully submitted,

J. B. REYNOLDS.

3540

PART III.

THE PROFESSOR OF ENTOMOLOGY AND ZOOLOGY.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to present my third annual report on the work of the department of Entomology and Zoology. My colleague, Mr. Tennyson D. Jarvis, and I carried out the prescribed lecture course during the winter term of this year. In the month of June last Mr. Lawson Caesar was appointed as an additional assistant in this department, with the special duties of investigating insect injuries and fungus diseases of fruit trees and other plants. During the current term he has taken a share in the educational work of superintending one of the divisions of the second year and the whole of the third year in their practical work. To the latter he has also given lectures on Economic Entomology, and has assisted Mr. Jarvis with the fourth year specialists in Histology.

At the final examinations conducted by the University of Toronto for the degree of B. S. A. in May last, all the fourth year students who were under instruction in this department were successful, five having taken the Biological option and three the Horticultural. Of these Mr. H. Groh has received the appointment of assistant Entomologist and Botanist at the Central Experimental Farm, Ottawa; Mr. L. Caesar, as already mentioned, a position in this department, Mr. J. D. Gilmour, assistant in the Department of Forestry at Ottawa; Mr. R. M. Winslow, teacher of Agriculture in the High School at Picton; Mr. A. M. W. Patch is continuing his studies in practical Forestry.

In the present Fourth Year there are five students taking the Biological option and eight the Horticultural. Of the former Mr. W. R. Thompson was employed during the summer by the Gypsy and Brown-tail Moth Commission in the State of Massachusetts as an assistant in the work connected with the importation and breeding of Parasites; Mr. R. C. Treherne held a somewhat similar position in the Cotton-Boll-weevil investigations in Louisiana, while Mr. A. Eastham was employed in rearranging and labelling the biological collections in the College Museum; Mr. A. C. Baker, now in his second year, spent the summer in charge of the Insectary work at the Agricultural Experiment Station, St. Anthony Park, Minn. These appointments which afforded the students exceptional advantages for the continuation of their special studies, were all obtained through the influence of this department.

The present fourth year students, who are taking the Biological option, are undertaking special scientific investigations in connection with the theses that they are required to present at the close of next term. Mr. E. W. Stafford is studying the life histories of the Pomace-flies (Drosophilidæ); Mr. R. W. Thompson, the Bird Mites (Analgesidæ); Mr. R. C. Treherne, the life-history and economic importance of the Sorghum Midge; Mr. A. Eastham, the Parasites of Scale-insects (Coccidæ).

During the month of July a share was taken in the instruction of the Summer School of Ontario and other Teachers; this consisted in lectures in elementary and practical Entomology which were given both out-of-doors

and in the lecture room, and field excursions for collecting insects and plants and observing birds and other living creatures. The keen interest taken by the members of the class in what was to most of them a new and unknown field for observation and study was very delightful to witness and made it a pleasure to do what one could to assist and instruct them.

Lectures were also given on economic and general Entomology to the Biological Section of the Canadian Institute, Toronto (Jan. 27); the Hamilton Horticultural Society (April 28); the Victoria County Teachers' Association (June 5); and at Erindale, County of Peel (Nov. 17). Mr. Jarvis gave two lectures on "Insect and Fungus Diseases," to the Short Course in Horticulture, and one on "Poultry Parasites" to the Short Course in Poultry in January last; in February he gave two lectures at Stoney Creek to the members of the Fruit Institute on "Birds in Relation to Horticulture," and the "Insect and Fungus Pests of Fruit"; at Waterdown a lecture on "Insects and Diseases affecting Vegetables and Fruits" (March 10); and at Toronto before the Vegetable Growers' Convention an address on "Combatting Insect and Fungus Foes of Vegetables" (Nov. 12). Mr. Caesar gave two addresses to the Farmers' Institute meeting at Picton (Nov. 16 and 17) on the "Fungus Diseases of Fruits."

PUBLICATIONS.

In addition to editing the monthly issues of the "Canadian Entomologist" and the annual report to the Legislature of the Entomological Society of Ontario I have contributed a number of short articles in answer to enquiries in the Farmers' Advocate and other agricultural journals, and also an article on the "Injurious Insects of 1908 in Ontario" to the annual report of the Entomological Society. In the Transactions of the Royal Society of Canada has been published my eighth annual "Bibliography of Canadian Entomology."

Mr. Jarvis has edited the "Ontario Natural Science Bulletin: The Journal of the Wellington Field Naturalists' Club" for 1908; and contributed the following articles: "The Gall Insects of Ontario," "Some additional Scale Insects of Ontario," and "Apparatus for collecting small aquatic and terrestrial Arthropods," annual report of the Entomological Society; "The Rodents of Ontario"—Ontario Natural Science Bulletin, and a number of short articles in the "Canadian Horticulturist."

Mr. Caesar has issued Press Bulletins which have been published in a large number of the newspapers of Ontario on "The Shot-hole Borer or Fruit-bark Beetle," "The Hessian Fly," "Brown-rot the cause of gum exudations on Peach-trees," and "Cankers on Apple-trees."

CORRESPONDENCE.

A considerable portion of our time, especially during the summer months, is taken up with correspondence; enquiries come in from all parts of the country every day asking for information regarding a great variety of insects. In the early part of the season examples of the Oyster-shell Bark-louse and other Scale insects were received from at least twenty different counties, the senders in many cases fearing that they were afflicted with the dreaded San José scale. A scale which has seldom been observed in Canada was found this year in large numbers on an elm tree in Toronto; it was identified as *Gossyparia ulmi*, an imported European species which is becoming widespread in North America.

Among forest and shade tree injuries may be mentioned the defoliation of Spruce trees at Whitby by the caterpillars of the Fir Saw-fly (*Lophyrus abietis*); the destruction of an enormous number of Tamaracs on the north shore of Lake Superior by the Larch Saw-fly (*Nematus Erichsonii*), which has gradually been spreading from the Province of Quebec till it has now reached the country west of Fort William, killing the larches wherever it goes. The Spruce Gall-louse continues abundant, especially affecting young trees; the Tussock Moth, which can easily be kept within due bounds by destroying the egg-masses in winter, has been allowed to remain unchecked and to defoliate the shade trees in several cities and towns. Maples have been attacked in several places by the boring grubs of the Pigeon Tremex, and the foliage rendered unsightly by Eriophyes galls. Some basswood trees in Toronto and elsewhere have been much injured by the galleries excavated in the wood by the large black Carpenter Ant.

Numerous complaints have been received regarding domestic insects, such as Buffalo-beetles, Clothes-moths, Bed-bugs, Cockroaches, and Ants, which cause so much annoyance and loss to careful house-keepers. It is hoped that the information afforded by the Department has served in many cases to allay anxiety and to bring about relief from the obnoxious insects. One rather unusual occurrence was the finding of numbers of the so-called Silver-fish (*Lepisma*) in a house at Mt. Salem; this small insect is covered with shining silvery scales like those of a fish, hence its name—and feeds upon starchy substances, occasionally being injurious to the binding of books as well as clothing.

Farm crops as a rule have been little affected this year. The Hessian fly was reported from a few counties, and Cut Worms inflicted much damage upon a variety of crops. The chief outbreak was that of Plant-lice (*Aphis*), on Turnips and Cabbage; in the autumn they were present in enormous numbers all over the country and many fields of these plants were rendered almost worthless by the attack. The hot dry weather which prevailed from the middle of August was very favorable to their multiplication. Wire-worms and White-grubs were much complained of. Flea beetles were bad on corn, turnips, beets and potatoes; the Pea-moth caused some damage in the neighborhood of Lindsay, but the Pea-weevil does not seem to have been as widespread as usual. Fumigation with carbon bisulphide is a cheap and easy remedy if the pea growers would only adopt it everywhere. The yield of Clover-seed was much reduced in places by the Clover-seed Midge for this also there is a simple remedy, viz., cutting or pasturing off the first crop before the middle of June and thus getting a full second crop uninjured by the maggots.

Vegetables have suffered from the usual attacks of their special insect foes, but there has been no remarkable outbreak such as that of the Variegated Cut-worm last year. Fruit-tree insects are referred to in another part of this report.

The correspondence we receive is of much value and interest to us, as it brings to our notice many attacks which we should otherwise know nothing about, and at the same time we have reason to believe that we are able to give useful advice and information to those who apply to us.

FUNGUS DISEASES AND INSECT PESTS.

The practical work in fungus diseases and insect pests has fallen very largely to Mr. L. Caesar, who was appointed to our department in June of this year. This line of work has been increasing very rapidly but the pressure of other duties has hitherto prevented its getting as much attention as

it deserved. In addition to identifying whatever diseases or insect pests are sent to him and giving the latest and best known methods of treatment, Mr. Caesar has visited a number of orchards throughout the province at the request of their owners to discover, if possible, the cause of the unhealthy condition of their trees and to advise them in the matter of treatment. For this purpose or in order to investigate diseases on his own part, he has visited during the summer orchards at Grimsby, St. Catharines, Niagara Falls, Niagara-on-the-Lake, London, Simcoe, Leamington, Chatham, Essex, Sandwich, Zenda, Lindsay, Whitby, Oshawa, Belleville and in Prince Edward County. In the last four districts the inspection of orchards was made in company with the local agricultural representatives, Messrs. Hare and Winslow respectively. These trips have been of great benefit, not only to the farmers interested but also to the department. They have helped much to show what diseases and insects at the present time require most attention and have likewise given an opportunity to make collections for class instruction of most of our worst diseases and insects. The specimens thus brought back, together with insects reared in the insectary have furnished material for many "Riker mounts," illustrating our worst fungus diseases and insect pests. These mounts have been found very serviceable not only for teaching purposes but also for fall fairs and demonstrations on other occasions. The orchard inspection work, moreover, when carefully done, is no small factor in bringing the farmers and the College into close touch with mutual benefit.

In addition to this kind of work much time has been devoted to original investigations. One of these was an attempt to discover the cause of the abnormally large number of gum exudations on peach trees last spring in the Niagara district, especially in the neighborhood of St. Catharines, where it was feared that some new and very destructive disease had suddenly appeared.

At the request of the Department of Agriculture Mr. Barlow of the Bacteriological department and Mr. Caesar were sent to the district to investigate. Mr. Barlow soon discovered that the disease was not due to bacteria. Mr. Caesar then continued the investigation to see whether a fungus might be the cause. Specimens of diseased parts were sent to different experts in the United States, and acting on a suggestion received from Mr. A. D. Selby, of Ohio Experiment Station, who expressed the opinion that at least some of the trouble might be due to the Brown Rot (*Sclerotinia fructigena*), which attacks the fruit of the peach, cherry and plum, a number of inoculations with this disease were made on young peach trees on June 24th and again on July 1st and 2nd. In some cases the fungus was taken directly from rotting cherries near by and in others from pure culture in wort-gelatin. Check inoculations with a sterilized scalpel were made on each occasion. A few inoculations were also made at the same time with pure cultures from other fungi obtained from diseased spots on the affected trees at St. Catharines. In about a week all the places inoculated with Brown Rot had begun to exude gum freely, and inoculated twigs soon became girdled and broke off with the wind. The checks in all but one case rapidly healed over without any exudation of gum, as did the inoculations with the other kinds of fungi, with the exception of three which produced a slight amount of gum. These, however, did not continue to increase when the grafting wax which had been used to cover them was removed and soon dried up, contrary to the conduct of the Brown Rot inoculations. The gum on the latter was in December still to be seen as a dark hard mass.

An experiment was also made to see whether the disease could enter through the lenticels or breathing places on the healthy bark. The result

It was not possible on account of scarcity of peach trees at the College and the enforced absence of the investigator on other work to extend these experiments so far as one could have wished this year, but sufficient has been done to show that the Brown Rot could produce the disease, and as old diseased mummy peaches and plums were to be found in the orchards affected, it was natural to suppose that these, whether on the trees or on the ground, were the cause of the trouble. Observations in orchards since the experiments have revealed so many cases of dead twigs and gum exudations intimately associated with Brown Rot on the fruit that there seems practically no doubt that the cause of the abnormally large number of gum exudations can be ascribed to this fungus. The only explanation that we can give at present of why it should have been so much more severe than usual in its attack this spring is that the long continued wet weather in May softened the tissues of the bark and gave the spores ideal conditions for germinating and getting a footing in the trunk and branches either through cracks or lenticels.

It should be remembered that gum exudations in peach trees may be due to wounds of any kind, such as those made by the Shot-hole Borer, Peach tree-borer, or by implements in cultivation. Such causes can, however, easily be recognized by removing the gum, whereas in the above case the work of the fungus is clearly a different thing.

After the experiments had been ended and sufficient observations made in orchards to corroborate the conclusions arrived at, a brief Press Bulletin entitled "Brown Rot a Cause of Gum Exudations on Peach Trees" was prepared and sent to the local press in all the peach growing districts. This article described the appearance of affected trees and suggested remedies. These are all in the nature of prevention rather than cure. The first step is, the removal and burning of diseased fruit on or under the trees as soon as possible after the picking season. Plum trees should be looked after as carefully as peach trees. Having seen to the destruction of the diseased fruit, care must be taken to see that the trees are properly sprayed. The first spraying, which should be just before the buds burst, may be either with the ordinary lime-sulphur boiled for one hour or with Bordeaux mixture. As Bordeaux later than this is dangerous to the peach foliage, some other spray mixture should be used.

Experiments at Washington this year have shown that self-boiled lime-sulphur of the strength of 5 lbs. sulphur, 10 lbs. lime, and 40 gals. of water will not injure the foliage and will very largely control both the Brown Rot and the Peach Scab. As high as 10 lbs. sulphur and 15 lbs. lime to 40 gals. of water were used without injury. To make this mixture put the 10 lbs. of fresh stone lime in a barrel and add about two gallons of boiling water, at once put in the 5 lbs. of sulphur and add a little more boiling water. Stir occasionally to prevent burning and when not stirring keep the barrel covered with an old rug or sack to keep in the heat. A minimum amount of water will hasten the cooking process. When the boiling has ceased add enough cold water to make 40 gallons of the mixture. Strain carefully and apply at once, keeping the liquid well agitated all the time to prevent settling. Arsenate of lead or Paris green may be added if desired for the Plum Curculio.

The first application of this mixture should be just after the blossoms fall, and two more applications should be given after this at intervals of two weeks between them.

Another subject which has been receiving much attention from Mr. Caesar is cankers on apple and pear trees. In this investigation Mr. Winslow of Picton and he have worked to a large extent together. On account of the great amount of damage ...

that Messrs. Winslow and Caesar should at once make a trip to Ithaca and Geneva, where these diseases have probably been studied more carefully than anywhere else in North America. At Cornell University Prof. Whetzel very kindly examined the specimens brought and identified the cause in most cases as Black Rot (*Sphæropsis malorum*) and in a few as Blight (*Bacterium amylovorum*). He also gave many valuable suggestions as to the best methods of treating the disease and showed an orchard in which cankers had been successfully treated by himself.

Since returning from Cornell a great deal more information has been gained not only about the amount of damage being done in different localities but also about the way in which each disease acts upon the trees and the varieties that are most subject to attack. These cankers have been formed to a greater or less extent in almost every orchard from Sandwich to Belleville, but are, as far as has been observed, most abundant and destructive in orchards east of Toronto along the north shore of Lake Ontario, being especially severe in Prince Edward County and the mainland opposite.

On account of the ravages the disease was making and the need of getting the farmers interested so that they might take the necessary measures to prevent further loss to their trees a press bulletin on the subject entitled "Cankers on Apple Trees," was prepared and copies sent to more than 400 newspapers throughout the province. The following is a copy of the bulletin:

CANKERS ON APPLE TREES.

"Many Ontario apple growers have complained that an unusually large number of branches are dying on their older apple trees and not a few of the younger trees have been killed outright. The trouble has usually been attributed to Sun-scald and Oyster-shell Scale. Investigations this autumn, however, have shown that the greater part of such damage can be traced to cankers, caused either by a fungus disease known as Black Rot or a bacterial disease known as Pear Blight, Fire Blight, or Twig Blight. The Black Rot attacks also the leaves and fruit causing the latter to rot. On the surface of the rotten fruit little black pustules or pimples almost one-third the size of a pin-head appear after a time. These pimples contain spores which when set free are carried by the wind from tree to tree and help spread the disease in the summer. Either kind of canker may cause diseased areas on the trunk and large branches or at the main crotch. It is not easy to tell in every case to which disease a canker is due.

"*Blight Canker*, however, often begins by attacking a water-sprout and running down into the trunk, crotch or main branch and forming a large dead area there. At this time of year such areas caused by blight are usually distinctly marked off from the healthy bark by a crack between the two, and by the diseased bark being darker brown in color than the healthy bark and slightly shrunken. As a rule the surface of Blight Cankers is fairly smooth, not rough, checked or blackened and is free from pimples except in old cankers where other diseases have got in and caused them.

"*Black Rot Canker* on the other hand is as a rule not distinctly marked off by a crack between it and the healthy bark. The central part, especially if more than a year old, is often but not always somewhat swollen and the bark is rough, black and checked. On part of the smoother surface there will often be found numerous little black pimples or pustules about one-third the size of the head of a pin. These are the places where spores are produced that spread the disease in the spring of the year.

"Both kinds of cankers may live over from year to year and continue to increase in size. This is especially true of Black Rot Canker, though often this, as well as the other, may die out at the end of the first year. The diseased area may be small in either kind or again it may include the whole of the trunk and part of the branches, or may run for several feet along a single branch. In old trees only the branches are attacked. Black Rot Cankers are often formed on the under side of the branch.

"*Remedies*: Where a tree is too badly attacked to give any hope of its recovery, it should be cut down and burned as soon as possible for, otherwise the disease will spread from it even though the tree itself be dead. In the same way dead or dying branches should be cut off and burned either this fall or early next spring, taking particular pains to see that the cut is made several inches below any trace of the diseased area. All cuts thus made should be disinfected in the manner described below and then painted. If this is done the frost will not injure them. Wherever a healthy stub is left after cutting off the cankered part of a branch it can be cut afresh in the spring and grafted.

"Where the cankered areas are not too large, especially on the trunk and crotches, they should be neatly cut out with a knife or some sharp instrument until the healthy bark is reached. The wounds thus made must be disinfected and painted with white lead or paint free from turpentine. The painting should be repeated next spring to make sure that no disease gets into the wounds. The best disinfectant to use is corrosive sublimate of the strength of 1 part by weight to 1,000 parts of water. Any druggist will supply the substance and explain how to make it up. The material will cost only a few cents. A wooden or glass vessel must be used instead of iron or tin as the substance will corrode them. Corrosive sublimate is deadly poison when taken internally, so care must be taken not to allow anything to drink the liquid, and to wash the vessel thoroughly before using it for any other purpose. The best way to disinfect the wound with corrosive sublimate is simply to tie a little sponge or a small pad of cloth on the end of a stick and, after dipping it into the liquid, wash over the surface of the wound. This will kill any kind of germ whatever.

"To ward off cankers for the future it is necessary (1) To prevent as far as possible injury to trees by such means as tearing off the bark by whiffle-trees or other implements or by boots in climbing. If wounds are made in this way, they should be disinfected and painted at once; otherwise they let in germs of the disease. Cankers usually start in wounds of some kind though sometimes these may be very small. Sun-scald injuries also allow Canker germs to enter, hence young trees should be protected against Sun-scald by some one of the well-known devices for this purpose. (2) Water-sprouts should be kept off the trunks and main branches, because, as said above, the Blight disease often runs down one of these and starts the canker below. A few minutes will usually suffice to remove all the water-sprouts from any ordinary tree. (3) The trees must be carefully sprayed with Bordeaux mixture and special pains taken to see that the trunks and main branches are thoroughly covered with the Bordeaux. The first spraying should be done just before the leaf buds burst, the second a few days before the blossoms open, and the third within a week after most of the blossoms have fallen. Four to eight ounces of Paris green should be added to each barrel of Bordeaux and the whole kept well agitated while spraying. The spraying will then not only do a great deal to keep off cankers but will also kill most of the codling moths (which cause the wormy apples), the cigar case-bearers, pistol case-bearers, canker worms, bud moths, and many other insects; and in addition will keep the apples free from scab, so that orchard-

ists should thus get a return for the time and money spent in the form o. healthier trees and more and better fruit. Care should be taken in every case to see that the spraying is thoroughly done at the time mentioned. Orchards that are kept properly pruned and sprayed have been found to be very much less affected with canker than those that are neglected."

Mr. Caesar's inspection of orchards has given him an opportunity for making some observations on insect pests as well as fungus diseases.

The following is a brief account of some of the more important things noted:—

In more districts than ever before farmers are using the lime-sulphur wash against the San José scale. Wherever this mixture is properly made and applied it has given excellent results. In some counties and particularly in Kent many farmers have been receiving such low prices for their apples that as soon as they find the scale in their orchards they become discouraged and believing that the cost and trouble of fighting it are greater than the returns they would get, are allowing their orchards to fall a prey to the insect. The great need in such districts seems to be the formation of up-to-date fruit growers' co-operative associations with intelligent, well trained orchardists at their head. Such an organization has been formed at Chatham and has already done good work, though much still remains to be done.

The Oyster-shell Scale, or Apple Bark Louse, especially in the eastern and middle parts of the province, is very abundant and destructive. A vigorous warfare is being carried on against it in various districts and many orchards are now almost free from the insect. The favorite remedies are,—

(1) Whitewash applied twice in the autumn as soon as possible after the leaves have nearly all fallen—strength 1½ lbs. fresh lime to 1 gallon water;

(2) The Lime-sulphur wash applied as late as possible in the spring before the buds burst;

(3) Gillett's Lye applied any time in the spring before the bursting of the buds;

(4) Kerosene emulsion used when the young lice are running, that is about the first week in June.

An interesting and encouraging feature about the insect is that where orchards are carefully sprayed three times a year with Bordeaux mixture for the Apple Scab this treatment alone serves in most cases to control the scale.

The Leaf Blister Mite of the Apple and Pear seems to be spreading pretty rapidly and is now found in numerous districts where a few years ago it was unknown. It can be successfully controlled by means of spring or fall application of either lime-sulphur or of 20 per cent. kerosene emulsion. As the mites winter under the bud scales special pains must be taken to see that these are thoroughly covered by the spray.

The Apple Maggot or Railroad Worm is doing considerable damage in Prince Edward County. It is also found in a few other districts but does not seem to spread rapidly. In spite of the fear of many farmers that this insect cannot be controlled there is very little doubt that if the fallen fruit were destroyed each day the pest would soon be wiped out of an orchard. An instance was found where this method had been followed with the result that the orchard was almost free from the insect this summer though badly affected a few years ago.

The Lesser Apple Worm has been charged with doing much damage in orchards this season, but of all the fruit sent in or examined in the orchards only a very small percentage had been injured by this insect. The Lesser

for Dr. James Fletcher recorded its presence in this province several years ago. Its life-history is about the same as that of the Codling Moth and the same remedies are used for both pests. The worm of this insect eats the pulp of the apple beneath the skin and generally leaves a large irregular blotch which greatly disfigures the fruit. The cavity formed usually differs distinctly from that of the Codling Worm, and unlike the latter, very seldom reaches to the core. Many little hemispherical cavities beneath the skin with a small opening through the centre to the exterior are often formed in apples. Some have mistakenly attributed these to the Lesser Apple Worm. They are probably caused by the Plum Curculio when feeding.

The best remedy for this insect, when attacking apples is to cultivate the orchard thoroughly up to July, and thus keep out all weeds and rubbish. Careful pruning also helps; for it has been found that the more sunlight can reach the fallen apples and the less rubbish there is the fewer the curculios are. Of course hogs running in an orchard help greatly, and spraying for the Codling Worm will kill a large number of the curculios also.

The Shot Hole Borer, also known as the Fruit-tree Bark Beetle or Pin Borer, is an insect that threatens to become very destructive in the Niagara district unless the fruit-growers will co-operate and take the simple steps necessary to control it. The insect is a tiny black beetle about 1-12 in. long. It attacks as a rule only dead or dying trees, but when very abundant often attacks perfectly healthy ones, preferring cherry trees in most districts, although not infrequently attacking the plum and peach as well. Wherever it bores through the bark of a healthy tree it causes gum to exude, and often trees are found with thousands of these little gum masses. Its attacks are worst from about the middle of May to the middle of June and again from about the end of the first week in August to the end of September or even later.

The complete control of this insect requires that all the farmers of the district should co-operate in cutting down and *burning* all the dead and dying fruit trees of every kind in their orchards. This should be done sometime between the late fall and early spring when the beetles are still dormant and cannot escape. If only a few farmers follow this course they may not succeed in saving their trees because the beetles often fly for considerable distances from orchard to orchard. Hence the necessity of all working together is quite apparent.

An attempt will be made before spring opens to interest the fruit-growers and get them to take the necessary steps to prevent further destruction of their trees by this borer.

Experiments with Insecticides.

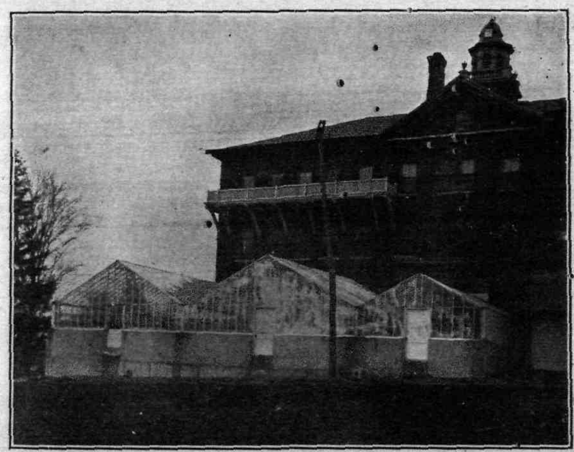
In order to test afresh a number of insecticides, the following experiments were conducted:

(1) On July 20th, Poisoned Bran, made according to Dr. Jas. Fletcher's formula, was used for Cut Worms that were seriously injuring turnips on the College farm. The mixture was applied at twilight and 25 lbs. were used, a quantity sufficient in this case for ½ of an acre. The result was remarkably successful and corroborated the claims made by others for this remedy. We can heartily recommend it to farmers and gardeners as an excellent remedy for cut worms.

(2) On July 24 and again on the 27th, experiments were made with fresh Pyrethrum or Insect Powder to test its effect upon Cabbage worms, which have been very abundant this year. This insecticide was used first as a dry

powder, and secondly as a liquid spray in the proportion of 1 oz. of the substance to 2 gals. of water. The application in the first case was made with a dust sprayer, and in the second with a knapsack sprayer. Contrary to expectation the latter method gave more satisfactory results and was also more economical. Every caterpillar touched, *i.e.*, over 80 per cent., was killed. It also killed the chrysalids. The powder cost 40 cents a lb. and 1 oz. at the dates mentioned was sufficient to treat more than 100 plants.

The experiments showed that Pyrethrum was a very satisfactory remedy for Cabbage worms. Its advantage over Paris green lies in the fact that it is not poisonous to man.



The Insectory—from the Vegetable Garden.

(3) At different times during the season experiments were made against several species of aphids or plant lice with kerosene emulsion, whale-oil soap, and simple soapsuds. The object was chiefly to see whether the soapsuds would give as satisfactory results as either of the other washes. It was found in every case tested that there was very little, if any, difference between the efficiency of these three remedies, using kerosene emulsion at the strength of $6\frac{2}{3}$ per cent. kerosene, whale-oil soap, 1 lb. to 6 gals. water, and soap-suds, 1 lb. soap to 4 gals. water. The only soaps tested were Sunlight and Royal City. There was practically no difference between these.

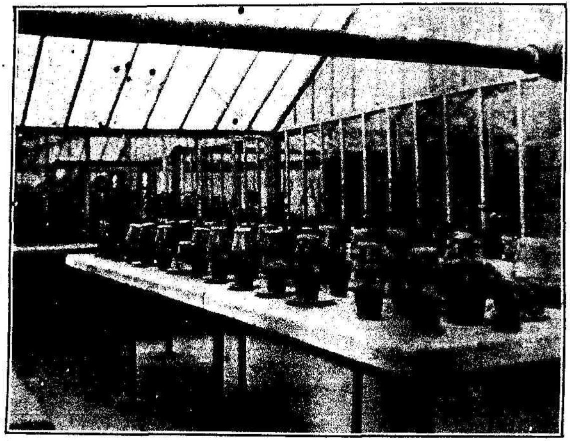
When spraying Cabbage Aphids and other mealy species (that is those covered with a waxy secretion) it was observed that the insects were seldom killed if they were merely touched by the spray: to make the treatment effective they had to be drenched.

(4) A test made with the commercial lime-sulphur seemed to indicate pretty clearly that this mixture at the ordinary recommended summer

Fall Fairs.

In response to the request of the eight Agricultural representatives from this College stationed in different counties of the province, an exhibit composed of the worst fungus diseases, insect pests, noxious weeds and weed seeds was sent to each of the following fall fairs: Lindsay, Perth, Morrisburg, Winchester, Picton, Ameliasburg, Oshawa, Galt, Collingwood and Essex. In addition to this, exhibits were sent to Renfrew, St. Catharines, and Toronto fairs and a very large special exhibit to the Ontario Horticultural Exhibition held in Toronto in November.

Wherever possible either Mr. Jarvis or Mr. Caesar went with the exhibition. In such cases they supplemented the collection by gathering as large and varied a display as time permitted of the diseases and weeds of the district in which the fair was held.



The Insectory—Central Room.

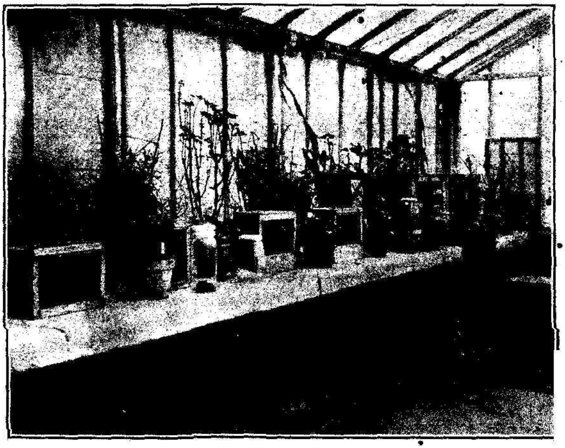
At each place attended numerous questions were asked by the farmers and much interest was taken in learning the names and best methods of treating the diseases, insects or weeds to be found on their respective farms. It was very evident in every case that the farmers were much pleased to have such an exhibit at their fair.

The Insectary.

It has been a source of much gratification to us that we have been able to make considerable use of the series of glass-houses forming the Insectary. Owing to defective construction they have not, however, proved as satisfactory as was to be expected. A large number of insects have been reared during the season and their life-histories more or less fully recorded; many

specimens have also been bred for the permanent collections and class-work, much more perfect examples being obtained in this way than by ordinary field methods. The accompanying illustrations will afford some idea of the building and the methods of work and observation employed.

THE MUSEUM. During the summer months the whole of the Biological and Geological cases were rearranged in systematic order and a large number of specimens were properly labelled. The visitor can now inspect the birds for instance in regular sequence of scientific orders; the other classes of animals are not so fully represented, but the examples we have are properly arranged. No additions deserving of special mention have been made during the year.



The Insectory—North-east Room.

I desire, in conclusion, to refer to the valuable assistance that I have received from Mr. Tennyson D. Jarvis throughout the year, whose work in both Entomology and Zoology has been conducted with the utmost zeal and industry, to the great benefit of the students and to the maintenance of the high standard of the department. During the last six months we have had also the assistance of Mr. Lawson Caesar who has taken a share in the class-room work of the term, and has done useful work in the inspection of orchards for fungus diseases and insect injuries. This welcome addition to the staff enables us to cover more fully than we otherwise could the various kinds of work which come within the scope of this department.

Respectfully submitted,

CHARLES J. S. BETHUNE.

PART IV.

THE PROFESSOR OF BOTANY.

To the President of the Ontario Agricultural College:

SIR,—I have the honor to submit my third annual report of the work of the Botanical department.

TEACHING.

There have been no changes in the personnel of our staff during the year. There have been a few changes made in the arrangements for instruction, however. A beneficial change has been made in the handling of the Botany in the First Year. In each disivion of the year we have divided the students into three sections. In the first we take those students who have never attended a High School or had instruction in Botany. In the second section, we take those who have had an equivalent of one year's High School work and only a very elementary introduction to Botany, and in the third section those who have a High School education equivalent to university matriculation. This arrangement makes classes of about twenty or twenty-five students of a somewhat equivalent preparation for each instructor, and it is generally agreed that larger classes for practical work, particularly in commencing the study of a science, are a disadvantage to teacher and pupil alike. In our case, I feel sure, our first year students are getting better grounding in the subject of Botany than they received formerly when we had larger classes. Messrs. Eastham and Howitt have taken over the work in Fungi and Plant Pathology. In preparation for this change Mr. Eastham spent his month's holidays in a special study of Fungi under Professor Atkinson, of Cornell University, and Mr. Howitt spent his holidays with Prof. Whetzel, of the Cornell Agricultural College, in the special study of Plant Diseases. The instruction in Fourth Year Plant Histology, formerly taken by me, has been placed in Mr. Eastham's charge.

EQUIPMENT.

During the year we have added to our equipment: (1) a splendid series of botanical charts by Kny, published by Paul Parey, Berlin, Germany; (2) a number of new pieces of apparatus for the work in plant physiology; (3) seven new microscopes for the use of the third and fourth year students; (4) three dissecting microscopes for the special study of grasses and weed seeds.

With the large increase in the number of students in the senior years, we find need for a larger number of microscopes. We should add at least ten to our supply next year. We find, too, increasing difficulty in accommodating students in the laboratories. There will soon be urgent need for laboratory re-arrangements if the classes increase in size.

Correspondence.

The amount of correspondence concerning fungous diseases, weeds and weed seeds increases year by year. During the winter and spring months numerous samples of clover, grass and grains were tested and reported on. Apparently the farmers and seed dealers of the Province are learning to take advantage of our services in these matters. Reports by Messrs. Eastham and Howitt on Weeds, Fungous Diseases and our Herbarium are included herewith.

Troublesome Weeds of the Year.

Judging from an analysis of the enquiries received during the past year the following weeds have been the most troublesome:

Perennial Sow Thistle (*Sonchus arvensis*), Bladder Campion (*Silene inflata*), Field Mustard (*Brassica sinapistrum*), Ragweed (*Ambrosia artemisiæfolia*), Twitch Grass (*Agropyron repens*), Dodder, (*Cuscuta epithymum*). All these weeds have been fully dealt with in previous annual reports or in bulletins issued by this Department and therefore will not be touched upon here. Two other weeds, however, which have not been previously discussed are worthy of mention, as numerous enquiries have been received concerning them during the past year. They are Crab or Finger Grass (*Panicum sanguinale*), and Small Flowered Cranesbill (*Geranium pusillum*).

Crab or Finger Grass. Many reports have been received that this grass was proving a pernicious pest in lawns. It is a spreading annual grass which lies close to the ground and roots at the lower joints. This prostrate habit of growth makes it almost impossible to cut it with the lawn mower and hence it frequently gets ahead of and crowds out the lawn grasses. This grass is easily recognized by the form of the inflorescence which consists of a number of spikes springing from the top of the culm, like the fingers on a hand, hence the common name Finger Grass.

Small Flowered Cranesbill. This is another plant which was brought to our attention by correspondents several times this year as a lawn weed. Patches of it were also found on several parts of the College campus. Judging by its prostrate habit and the rapidity with which it grows it is likely to prove quite a serious pest to deal with in lawns. It is a low-growing, diffusely branched annual plant with small purplish flowers and orbicular leaves which are deeply cleft into a number of lobes.

Recent Introductions.

Field Pepper Grass or Cow Cress (*Lepidium campestre*). This is a weed which was mentioned in our last annual report as spreading over Ontario as am impurity in Red Clover seed. This year it has been reported from many sections of the Province and in nearly every instance correspondents report finding it in Red Clover. Many of the samples of Red Clover seed examined here during the past year contained the seed of this weed. It is an annual or biennial weed and though it is not likely to prove troublesome on well tilled farms it is by no means a desirable introduction and Red Clover seed should be carefully examined for the seeds of this weed before being sown.

Roquette (*Eruca sativa*). This weed was reported as occurring in Ontario for the first time last year. This year it has been sent in from three different parts of the Province. In every case it has been reported as having been found in Alfalfa and has undoubtedly been distributed as an impurity

in Alfalfa seed. It belongs to the Mustard or Cress family (*Cruciferæ*) and in some parts of Europe is considered a very serious pest. It is therefore very important that every precaution should be taken to prevent it from becoming established in Ontario. This can only be accomplished by a careful inspection of all Alfalfa seed sown and by keeping constant watch on Alfalfa fields in order to destroy any specimens of this weed that may appear before they mature their seed.

RUSSIAN THISTLE (*Salsola Kali*, var. *tragus*). This weed has been found in waste places in many parts of Ontario for several years, but until this year has not been reported as being found to any extent in cultivated crops. This year, however, it has appeared in Alfalfa fields in many parts of Ontario and caused considerable alarm to those who were not acquainted with it.

The Russian Thistle is a smooth, bushy branched annual from one to three feet high. Mature plants are more or less spherical in form. The stems and branches are red in color. The leaves are awl-shaped, one to two inches long, soft and fleshy when young, very prickly pointed when mature. The flowers are inconspicuous, being small without petals, and solitary in the axils of the leaves. In several of the Western States this weed is a very serious pest. The plants, when ripe, break off near the surface of the ground and are rolled long distances by the wind, scattering their numerous seeds on their journey. It is this tumbling habit that makes this weed particularly adapted to the prairie lands of the West and it probably will never be a pest in Ontario, where fences, trees and other obstructions will prevent its being spread far and wide by the wind.

A NEW WEED.

BARNABY'S THISTLE (*Centaurea solstitialis*, L.). This plant, we believe, is almost new to Ontario. Its home is in the Mediterranean region, but it has been introduced into most warm countries with Alfalfa, clover and other seeds. It was first noticed growing in an Alfalfa field on the College farm. Later a sample was sent in by a correspondent who had found it in his Alfalfa field. It is probable, therefore, that it has been introduced as an impurity in Alfalfa seed.

Barnaby's Thistle is a bushy branched annual weed, from one to two feet high. It belongs to the Composite Family (*Compositæ*). The flowers are yellow and the upper bracts of the involucre terminate in stout yellow spines about three-fourths of an inch long. These spines are very conspicuous. The whole head is more or less woolly pubescent. The lower leaves are pinnatifid, the upper linear, entire and decurrent. This plant being an annual and very conspicuous is not likely to become a bad weed.

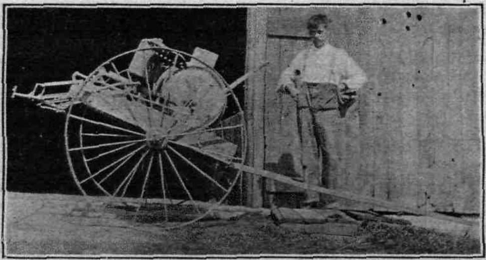
SPRAYING EXPERIMENTS.

Some years ago it was successfully demonstrated that Copper Sulphate could be used as a spray to kill mustard in grain crops. In March, 1908, Prof. Bolley, of the North Dakota Experiment Station, published a bulletin in which he gave results of spraying various weeds with Iron Sulphate which would indicate that it might be successfully employed to destroy Bindweed, Canada Thistle, Dandelion and Great Ragweed in growing grain without injury to the crop. In order to gain further information on this subject the Botanical department, during this past summer, carried on several experiments with Iron Sulphate as a spray to kill weeds.

Bindweed, Dandelion, Mustard, Chickweed, Canada Thistle, Burdock, Curled Dock and Annual Sow Thistle were sprayed with a mixture containing 75 pounds of Iron Sulphate to 40 gallons of water. This mixture was

applied with an ordinary spray pump, such as is used to spray fruit trees. Though no definite conclusion can be drawn from the experiments made, the results are indicative of what may be proved by further experiments.

A large patch of Bindweed in the College orchard was sprayed ten times with the Iron Sulphate at intervals varying from three days to two weeks. At each application of the solution nearly all the leaves and young shoots would be completely destroyed, but with remarkable rapidity the underground rootstocks would send up a fresh supply of new shoots and the patch would soon be as green as ever. An attempt was made to destroy the rootstocks by cultivating and harrowing them to the surface of the ground and then spraying them with the Iron Sulphate. This process was repeated twice and, though each time many of the rootstocks were killed, plenty still remained in the ground to send up new shoots at the first opportunity. The result was that a month after the spraying was discontinued the Bindweed was just about as thick as when the experiment was started. It would thus seem to be impossible to eradicate Bindweed by means of spraying with Iron Sulphate.



Potato Sprayer used for Spraying Mustard with an Iron Sulphate Solution.

A small patch of Dandelions on the campus was staked out and sprayed with the Iron Sulphate. The first application destroyed nearly all the Dandelion leaves without doing any apparent harm to the grass. In a few days, however, new leaves made their appearance. These were again sprayed with the Iron Sulphate and destroyed, only to be replaced by a fresh crop, which, however, were not nearly so vigorous as the first lot and when they were destroyed only a few spindly leaves were produced and none of the plants flowered and produced seeds. It thus seems probable that if lawns infested with Dandelions were given five or six good sprayings with Iron Sulphate at proper intervals during the summer the Dandelions might be greatly diminished in number without any apparent injury to the grass beyond a slight discoloration. This, however, remains to be demonstrated by further experiments on a larger scale.

Field Chickweed was completely destroyed by one thorough application of Iron Sulphate. It would thus seem possible that Iron Sulphate might be profitably used to destroy Chickweed in orchards and gardens where it often necessitates frequent cultivation and hand hoeing.

Annual Sow Thistle, Canada Thistle, Curled Dock and Burdock were apparently little harmed by Iron Sulphate. The foliage at each application

would be only partially destroyed and the plants soon seemed to recover their natural vigor.

The test to destroy Mustard with Iron Sulphate was not conducted by the Botanical department, but by Mr. A. Leitch, B.S.A., manager of Donlands Farm, Donlands, Ont. This gentleman wrote to the Botanical department in June enquiring as to the efficiency of Iron Sulphate as a spray to kill Mustard. The information available on the subject was sent to him with the request that he would report the results of his efforts. A week later Mr. Howitt visited Donlands Farm and was surprised and pleased to see how completely the Iron Sulphate had destroyed the Mustard with little or no apparent injury to the barley crop. The following report kindly supplied by Mr. Leitch will, however, give the best account of the experiment and its results:

Number of acres sprayed, 26.

Cost of spraying:

Material	$11 56
Labor, 2 men $1\frac{3}{4}$ days at $1.60	5 60
Total cost	$17 16

Strength of mixture, 75 lbs. copperas to 40 gal. water.

Spraying machine, Power Spramoter, Model 1904.

Number of nozzles, 6 ordinary Vermorel nozzles.

Time of application, from 8 a.m. to 6 p.m., warm, sunny days.

Efficiency of Spray. At this date (June 26th) just twelve days after application, there is not a living Mustard plant in the field except those missed by the spray, while the fields on surrounding farms are in full bloom. It is quite noticeable, however, that those plants which were in bloom at the time of spraying have, in a few instances, formed seed, though the seed pods and seeds are dwarfed and unhealthy looking. Those plants which were not in bloom when the field was sprayed were entirely killed and formed no seed whatever. Therefore our observations lead us to believe that the proper time to spray is just before the blooming period.

Clover Seed Investigation.

During the past winter and spring a large number of samples of clover and alfalfa seeds were examined as to freedom from weed seeds, dirt, etc., with the following objects in view:

1. To determine as far as possible the condition of clover seed as sown in Ontario as regards the number and kind of weed seeds contained.

2. To ascertain the weed seeds that are most commonly found in the various kinds of clover seed.

3. To note the new weeds that are likely to be spread through the Province as impurities in clover seed.

4. To get some idea as to whether the germination capacity of a sample of clover seed can to any extent be determined by the plumpness and brightness of the seeds in a sample.

5. To demonstrate the loss caused by buying clover seed containing a large percentage of dirt and inert matter such as is too often found in clover seed offered for sale.

This work is still in progress and it is hoped that by next fall enough data will have been secured from which to draw some definite conclusions.

In closing it should be stated that while some of the samples of clover seed examined were those submitted to the department for test as to purity by farmers and seedsmen, most of them were collected and sent in by the various District Representatives of the Ontario Department of Agriculture who kindly co-operated in this work and to whom the thanks of the Botanical department are due.

PLANT DISEASES.

During the year the usual number of enquiries has been received with regard to plant diseases. Some of these affections were due to physiological or obscure causes, others to well recognized fungus parasites. Amongst those of the latter class on which advice was given, the following may be mentioned:—Late Blight of Potato (*Phytophthora infestans*), Grain Rust (*Puccinia graminis*), more particularly in its relation to the Common Barberry, Black Knot (*Plowrightia morbosa*), Rose Mildew (*Sphærotheca pannosa*), Pea Blight (*Ascochyta pisi*), Clover Leaf Spot (*Pseudopeziza trifolii*), a Lettuce Rot (*Septoria consimilis*), Apple Scab (*Venturia pomi*), and a Rhubarb Leaf Spot due to *Phyllosticta Rhei*.

Spray Pump used for Spraying Buds with Iron Sulphate Solution.

FLESHY FUNGI.

A number of specimens of these fungi has been submitted to this department for identification and information. In some cases the inquiries have been prompted by motives of curiosity due to the peculiar appearance of many of the species. In other cases information was desired as to the edible or piosonous nature of the plants. Such information was supplied as far as is possible with our present imperfect knowledge of the culinary value of the various mushroom allies. One or two cases of trouble to mushroom growers through the appearance of large numbers of other fleshy fungi in the mushroom beds were investigated.

With a view to facilitating subsequent work in the identification of such material Mr. Eastham spent the greater portion of his vacation in

collecting, identifying and preserving specimens of Agaricineæ and Plyporaceæ. These specimens are now in the Herbarium, and it is hoped will form the nucleus of a collection which by further extension will become valuable for reference purposes.

HERBARIUM.

The work of last year has been continued and extended. The reference collection, numbering some 5,000 sheets, has been catalogued and the work of rearranging the specimens completed. A large number of new specimens has been added, chiefly selected from the collections required from students as part of their second and fourth year work. Many of the sheets added are those of common weeds, of which a large number of specimens is needed to replace those damaged by the wear and tear of class work, exhibits, etc. A number of new specimens, however, has been added to our collection, including the following:

Hypoxis hirsuta (L), Coville, (Star-grass); Ithaca, N.Y.

Stylophorum diphyllum (Michx), Nutt., (Celandine Poppy); London.

Arenaria macrophylla, Hook,, (Large-leaved Sandwort); B. C.

Lepidium ruderale, L., (Roadside Pepper-grass); Forest, Ont.

Sisymbrium canescens, Nutt., (Hoary Mustard); Haldimand, Ont.

Sisymbrium incisum, Engelm, (Tansy Mustard); Alberta.

Nasturtium sylvestre, R. Br., (Creeping Yellow Water-cress); Lincoln.

Erysimum parviflorum, Nutt., (Small Wormseed Mustard); Sask.

Hesperis matronalis, L., (Dame's Violet); Halton Co., Ont.

Thermopsis rhombifolia, (Nutt), Richards, (Prairie Thermopsis); Sask.

Petalostemon violaceus, Michx., (Violet Prairie Clover); Saskatchewan.

Astragalus pectinatus, (Hook.) Dougl., (Narrow-leaved Milk Vetch); Alberta.

Astragalus bisulcatus, (Hook.) Gray, (Two-grooved Milk Vetch); Alberta.

Viola rotundifolia, Michx., (Round-leaved Violet); British Columbia.

Hypericum prolificum, L., (Shrubby St. John's-wort); London, Ont.

Œnothera albicaulis, Pursh., (Prairie Evening Primrose); Alberta.

Vaccinium stamineum, L., (Deerberry); Ithica, N.Y.

Dodecatheon Meadia, L., var. frigidum, Gray, (American Cowslip); British Columbia.

Limonium Carolinianum (Walt.), Britton, (Sea Lavender); Mass.

Acerates viridiflora (Raf.), Eaton, (Green Milkweed); London, Ont.

Hydrophyllum appendiculatum, Michx., (Appendaged Water-leaf); London, Ont.

Cynoglossum virginicum, L., (Wild Comfrey); Komoka, Ont.

Mertensia paniculata (Ait.), Dom., (Tall Lungwort); Englehart, Ont.

Pycnanthemum linifolium, Pursh, (Narrow-leaved Mountain Mint); Komoka, Ont.

Buchnera americana, L., (Blue-hearts); London, Ont.

Plantago media, L., (Hoary Plantain); London, Ont.

Plantago Purshia, R. and S., (Pursh's Plantain); British Columbia.

Valeriana edulis, Nutt., (Edible Valerian); Springbank, Ont.

Centaurea solstitialis, L., (Barnaby's Thistle); O.A.C.

Respectfully submitted,

S. B. McCREADY.

PART V.

THE LECTURER IN PHYSICS.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to submit herewith my third report as head of the department of Physics.

INSTRUCTION.

(*a*) *Lecture Courses.*

In the first year the instruction in the department consists of courses in Arithmetic, Hydrostatics as a preparation for and followed by Soil Physics, and lastly a course in the principles of Mechanics. The work of the second year consists of Surveying, Drainage, and Farm Power and Farm Water Supply by electricity, wind and water. The third year make a specialty of Meteorology, Cold Storage, and Ventilation, based upon a thorough course in Heat. In the final year, Climatology, advanced Drainage, and advanced Soil Physics are emphasized.

(*b*) *Laboratory Work.*

Laboratory practice is given all the years, in the various subjects. With the increase in the number of students the capacity of our laboratories has become inadequate, with the present arrangement and equipment. I shall take the liberty of asking your consideration of a plan for increasing our laboratory capacity.

WEATHER REPORT.

Tables I. to III. give a summary of the weather data at representative stations which this department has equipped with the necessary meteorological instruments.

TABLE I. WEATHER REPORT OF 1908 AT THE O.A.C., GUELPH.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean temperature..........	20.9	17.3	31.9	38.8	55.9	65.4	69.5	65.2	64.5	50.9	37.5	24.4	45.2
†Departure from normal..	+ 1.0	− 1.6	+5.0	−2.5	+2.3	+2.2	+1.4	−1.0	+4.5	+4.5	+3.4	−0.4	+1.8
Highest temperature.......	44.0	43.0	44.0	72.0	83.0	86.0	89.0	88.0	88.5	79.0	60.0	50.0	89.0
Lowest temperature.......	− 18.0	− 19.0	17.0	15.0	29.0	40.0	48.0	42.5	33.0	24.0	20.0	10.0	−19.0
Snowfall in inches.........	34.5	13.0	2.5	......	......	......	......	......	......	......	4.0	10.5	64.5
Rainfall in inches.........	....	1.05	1.13	1.33	3.47	3.21	3.25	2.75	.73	.81	.78	.50	19.01
*Precipitation in inches..	3.45	2.35	1.38	1.33	3.47	3.21	3.25	2.75	.73	.81	1.08	1.55	25.46
†Departure from normal..	+ 1.97	+ .75	+ .01	− .21	+1.10	+ .26	+ .28	+ .54	−1.53	−1.52	−1.01	− .15	− .11

* Calculated by ten inches of snow being equivalent to one inch of rain.

† Normals based on 21 years' observations.

TABLE II. OUTSIDE STATIONS.

——	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.	Year.
Bay View, P.E.I.:													
Mean temperatures.....	20.6	18.5	25.4	32.0	41.9	56.9	64.9	61.7	59.8	51.1	34.7	21.2	40.7
**Departure from normal.	+ 2.9	+ 3.3	+2.1	−1.2	−0.9	+1.5	+2.3	+ .5	+2.3	+3.7	−0.8	−3.9	+ 1.0
Highest temperatures..	54.0	49.0	49.0	61.0	72.5	84.0	89.0	80.0	79.0	73.0	54.0	51.0	89.0
Lowest temperatures...	− 6.0	− 10.0	−5.0	6.0	29.5	36.0	40.0	39.0	39.0	28.0	15.0	−7.0	−10.0
Snowfall in inches......	27.90	....	......	9.10	.03	......	......	......	......	.50	6.90	40.80	85.23
Rainfall in inches......	1.73	....	1.05	2.79	2.24	2.30	1.62	7.64	.9	2.71	4.17	2.49	29.64
*Precipitation in inches.	4.52	....	1.05	3.70	2.25	2.30	1.62	7.64	.9	2.76	4.86	6.57	38.17
**Departure from normal.	+ .41	− 1.92	− .62	+ .35	− .29	+ .63	−2.76	+1.36	−2.78	− .92	+1.22	+1.50	− 3.83
Demonstration Farm (Northern Ontario)													
Mean temperatures.....	....	....	18.5	31.5	48.6	60.2	64.0	58.4	53.7	40.1	22.4	7.8	......
Highest temperatures.....	....	....	55.0	65.0	85.0	93.0	95.0	89.0	84.0	74.0	53.0	42.0	95.0
Lowest temperatures.....	....	....	-30.0	-22.0	20.0	24.0	30.0	34.0	24.0	9.0	2.0	-35.0	......
Snowfall in inches.....	....	....	5.0	2.5	......	......	......	......	......	1.00	18.0	25.5	......
Rainfall in inches.....	....	....	......	......	2.22	3.19	4.35	3.45	2.60	3.40	......	......	......
*Precipitation in inches.	....	....	.50	.25	2.22	3.19	4.35	3.45	2.60	3.50	1.80	2.55	......
Jordan Harbor (Lincoln)													
Mean temperatures.....	....	....	35.9	42.0	52.8	65.9	70.8	68.1	62.5	48.5	39.6	30.1	......
Highest temperatures.....	....	....	68.0	68.0	86.5	90.0	91.0	92.0	90.0	81.0	63.0	61.0	92.0
Lowest temperatures.....	....	....	18.0	22.0	30.0	43.5	52.0	46.5	40.0	20.4	22.0	11.0	......
Snowfall in inches.....	....	....	......	......	......	......	......	......	......	......	.85	2.4	......
Rainfall in inches.....	....	....	.81	1.42	2.45	2.41	4.39	1.02	.62	2.88	1.30	1.20	......
*Precipitation in inches.	....	....	.81	1.42	2.45	2.41	4.39	1.02	.62	2.88	1.39	1.44	......
Leamington (Essex Co.)													
Mean temperatures.....	25.8	20.4	34.8	44.4	57.7	67.6	72.5	69.3	66.3	53.0	39.0	28.9	48.3
**Departure from normal.	− 0.1	− .2	−1.4	+2.9	+4.4	+2.2	+0.4	+0.8	+2.3	+2.9	+0.3	−0.5	+ 1.1
Highest temperatures..	41.0	42.0	59.0	75.0	85.0	87.0	90.0	92.0	87.0	78.0	63.0	49.0	92.0
Lowest temperatures...	− 2.0	− 8.75	13.0	19.0	30.0	37.0	47.0	46.0	41.0	29.0	20.0	10.0	− 8.75
Snowfall in inches......	6.25	21.5	......	1.00	......	......	......	......	......	......	......	.5	29.25
Rainfall in inches......	2.01	.47	2.66	1.99	2.52	2.25	2.36	5.58	10	1.46	.73	.20	22.33
*Precipitation in inches	2.64	2.62	2.66	2.09	2.52	2.25	2.36	5.58	.10	1.46	.73	.25	25 26
**Departure from normal.	− 1.37	− .59	+ .16	+ .05	+ .10	−1.26	− .5	+2.20	−2.38	− .56	− .87	−1.11	− 6.99
Magnetewan (Parry Sound)													
Mean temperatures.....	9.3	8.7	21.0	33.8	51.9	60.1	65.3	61.3	60.2	46.5	33.4	19.5	39.3
†Departure from normal.	− 5.2	− 0.6	+1.3	−0.9	+5.0	−0.7	+0.9	−0.8	+2.4	+3.8	+2.9	+3.5	+ 0.4
Highest temperatures..	38.5	40.5	49.0	66.5	80.5	84.0	89.0	85.0	86.0	74.0	58.0	54.0	89.0
Lowest temperatures...	− 35.5	− 37.0	-10.0	−6.0	25.0	30.5	44.0	35.5	31.0	18.5	14.0	-23.0	−37.0
Snowfall in inches......	24.6	32.7	9.5	8.8	......	......	......	......	......	......	12.20	39.30	127.10
Rainfall in inches......	.38	.05	1.07	1.54	3.07	1.03	2.50	2.58	2.13	1.23	1.74	......	17.27
*Precipitation in inches.	2.84	3.32	2.02	2.42	3.07	1.03	2.50	2.53	2.13	1.23	2.96	3.93	29.98
†Departure from normal.	− .59	+ 0.64	−0.69	−0.18	+0.83	−2.15	+0.90	−1.82	−0.86	−1.95	−0.49	+ .74	−5.57
Maitland: (Grenville Co.)													
Mean tempertures......	16.4	6.6	24.8	36.4	54.9	64.8	70.5	66.6	64.1	52.3	38.2	19.5	42.8
†Departure from normal.	−1.4	−3.3	+7.8	−1.0	+4.1	+0.2	+2.4	−0.6	+1.6	+4.6	3.2	+1.0	−1.5
Highest temperatures...	41.0	38.0	50.0	65.0	82.0	86.0	92.0	85.0	84.0	79.0	60.	55.0	92.0
Lowest temperatures...	−28.0	−36.0	−3.0	11.0	33.0	39.0	50.0	43.0	39.0	29.0	21.0	−11.0	−36.0
Snowfall in inches......	4.6	3.15	3.10	......	......	......	......	......	......	......	1.00	12.00	23.85
Rainfall in inches	......	2.03	1.35	2.83	4.77	2.25	4.04	1.40	1.12	1.95	.50	......	22.24
Precipitation in inches..	4.6	2.35	1.66	2.83	4.77	2.25	4.04	1.40	1.12	1.95	.60	1.20	24.63
†Departure from normal..	−.95	+.98	−.10	+.62	+.69	−1.18	+1.89	+.25	−1.55	−.46	−1.38	−1.05	−1.13
Marksville: (St. Joseph Is.)													
Mean temperatures.....	20.9	17.1	23.3	35.1	51.0	60.0	65.9	62.1	60.3	47.9	35.6	21.5	41.7
†Departure from normal.	−1.3	+1.3	0.0	−2	+4.1	−.6	+1.0	−.3	−1.1	+3.4	+1.4	+1.5	+1.0
Highest temperatures...	37.0	41.0	49.0	59.0	73.0	83.0	87.0	82.0	82.0	78.0	57.0	43.0	87.0
Lowest temperatures....	2.0	0.	3.0	4.0	25.0	34.0	44.0	39.0	31.0	22.0	16.0	8.0	0.0
Snowfall in inches......	8.0	40.0	27.0	5.0	......	......	......	......	......	......	4.0	30.0	114.0
Rainfall in inches.......	1.0	.5	......	2.54	5.28	2.85	5.58	3.01	2.79	1.08	3.78	......	28.44
*Precipitation in inches.	1.8	4.5	2.7	3.04	5.28	2.85	5.58	3.04	2.79	1.08	4.18	3.00	39.84
†Departure from normal.	−2.	+2.4	+.04	+1.40	+1.65	−.79	+2.22	−.17	−1.06	−1.23	+1.12	+0.95	+6.31
St. Catharines: (Lincoln Co.)													
Mean temperatures	25.5	19.9	33.4	42.6	54.7	66.6	70.4	67.3	66.1	54.1	39.8	29.9	47.5
**Departure from normal.	......	+1.0	−.4	+2.4	+6.4	+2.0	+.2	+.5	+1.1	+3.7	+0.9	−0.6	+0.6
Highest temperatures...	42.0	43.0	65.0	72.0	87.0	89.0	92.5	93.0	92.0	83.0	67.0	62.0	93.0
Lowest temperatures...	−1.0	−4.0	16.0	22.0	30.0	43.0	53.0	45.0	39.0	29.5	21.0	+7.0	−4.0
Snowfall in inches......	7.75	15.5	2.01	......	......	......	......	......	......	......	2.50	5.00	32.79
Rainfall in inches......	1.52	1.99	2.40	2.11	2.70	......	......	2.73	.71	.75	1.19	.60	......
*Precipitation in inches	2.30	3.54	2.60	2.11	2.70	......	......	2.73	.71	.75	1.44	1.10	......
**Departure from normal.	......	+1.01	−.22	+.39	−.18	......	......	+.60	−1.32	−.98	−.63	−1.78	......
Sturgeon Lake: (Victoria)													
Mean temperatures.....	17.8	14.9	24.0	37.7	54.4	64.8	69.3	65.3	63.1	49.1	35.5	21.6	43.1
Highest temperatures...	38.0	42.0	+47.0	67.0	83.0	88.0	93.0	87.0	87.0	78.0	60.0	56.0	93.0
Lowest temperatures....	0.0	0.0	0.0	13.0	27.0	39.0	48.0	40.0	34.0	24.0	10.0	1.0	0.0
Snowfall in inches......	16.0	28.0	6.0	2.5	......	......	......	......	......	......	6.50	15.0	74.00
Rainfall in inches......	......	.6	.2	2.25	2.39	.56	2.85	1.40	1.35	.30	1.50	......	13.40
*Precipitation in inches	1.6	3.4	.8	2.50	2.39	.56	2.85	1.40	1.35	.30	2.15	1.50	20.80
Walkerton: (Bruce Co)....													
Mean temperatures.....	......	......	......	41.6	56.4	64.8	69.2	64.7	64.5	51.1	40.2	25.4	......
Highest temperatures...	......	......	......	71.0	85.0	90.0	92.0	91.0	90.5	78.0	60.0	38.0	......
Lowest temperatures...	......	......	......	14.0	29.0	35.0	46.0	40.0	36.0	26.0	24.0	12.0	......
Snowfall in inches......	......	......	......	6.50	......	......	......	......	......	......	......	......	......
Rainfall in inches......	......	......	......	2.65	3.27	2.63	2.38	.56	1.68	.84	2.87	.30	......
*Precipitation in inches	......	......	......	3.28	3.27	2.63	2.38	.56	1.68	.84	2.87	.30	......

*Calculated by ten inches of snow being equivalent to one inch of rain.

**Normals based on two years' observations.

† Normals based on three years' observations.

TABLE III. LENGTH OF SEASON AT VARIOUS STATIONS.

Station.	Last killing frost in spring.		First killing frost in autumn.		No. of days between.	Average length of season free from killing frost.
	Date.	Deg.	Date.	Deg.	1908.	
Guelph	May 2	30	Oct. 3	25	154	*145 (21)
Bay View, P.E.I.	" 16	29.5	" 21	28	158	149 (2)
Demonstration Farm	July 20	30	Sept. 3	24	45	....
Jordan Harbor	May 23	30	Oct. 21	30	151	....
Leamington	" 3	30	" 12	29	162	158 (2)
Magnetewan	" 5	25	" 3	24.5	151	125 (3)
Maitland	" 29	14	" 3	29	127	142 (3)
Marksville	" 5	26	" 2	26	150	131 (3)
St. Catharines	" 4	30	" 12	29.5	161	162 (2)
Sturgeon Lake	" 7	27	" 3	27	149	....
Walkerton	" 5	29	" 3	29	151	....

* Numbers in brackets denote number of years observations from which averages are taken.

In Table No. II. we find four new stations—to one of which, viz.: Demonstration Farm, I wish to call attention. It is located in the Abitibi region, in the Great Clay Belt of New Ontario, 350 miles north of Toronto, as the crow flies, and about 180 miles from the James Bay. At the suggestion of the Hon. Nelson Monteith an observing station was established in order that the Department of Agriculture might have some definite knowledge as to the climatic conditions existing there. Perhaps the best way to gain an idea of the climate of the Great Clay Belt is by comparison, each reader choosing for the purpose the station in Old Ontario with which he is most familiar. We in Guelph, for instance, would make the following comparisons:—

TABLE IV.—Comparison of Climates of Guelph and Demonstration Farm.

	Mean Temperature.		Highest Temperature.		Lowest Temperature.		Precipitation.	
	Guelph.	Dem. Farm.	Guelph.	Dem. Farm.	Guelph.	Dem. Farm.	Guelph.	Dem. Farm.
March	31.9	18.5	44.0	55.0	17.0	—30.0	1.38	.50
April	38.8	31.5	72.0	65.0	15.0	—22.0	1.33	.25
May	55.9	48.6	83.0	85.0	29.0	20.0	3.47	2.22
June	65.4	60.2	86.0	93.0	40.0	24.0	3.21	3.19
July	69.5	64.0	89.0	95.0	48.0	30.0	3.25	4.35
August	65.2	58.4	88.0	89.0	42.5	34.0	2.75	3.45
September	64.5	53.7	88.5	84.0	33.0	24.0	.73	2.60
October	50.9	40.1	79.0	74.0	25.0	9.0	.81	3.50
November	37.5	22.4	60.0	53.0	20.0	.2.0	1.08	1.80
December	24.4	7.8	50.0	42.0	10.0	—35.0	1.55	2.55

The first two columns show for every month a lower mean at Demonstration Farm in Northern Ontario, than at Guelph. The second two, with the exception of March, show that in Northern Ontario the maximum temperatures for Fall, Winter and Spring are lower than at Guelph, and the Summer maximums (June, July and August) higher, giving a climate of greater extremes than Guelph. I am unable to explain the unusually high maximum at Demonstration Farm in March. On or two other places that are north of Guelph also shew a higher maximum for March than does the latter. The sixth column shews that there was frost at Demonstration Farm in every month but August, that in July not being very severe, only two degrees below freezing. And comparing columns five and six we see that Demonstration Farm had in all months lower *minimum* temperatures than had Guelph. The precipitation, shewn in the last two columns, is also worthy of notice. For the first eight months of the year precipitation at Guelph was much in excess of the normal (see Table I.), but during September, October and November it was very low, amounting to only one-third the average for those months during the last twenty years. Precipitation at Demonstration Farm has been the reverse of that of Guelph (columns 7 and 8, Table IV.), viz., scant in the early months but excessive from July to December.

In connection with the reports it may be of interest to record that our observer, Mr. W. McLaren, sent us from the north in September samples of potatoes, cucumbers, tomatoes, and oats grown there. They were all fine samples, the oats being extra well filled with plump, heavy grain. In commenting on the samples Mr. McLaren says: "The seeds were all planted at the end of May, with exception of the tomatoes, which were planted late in June. We had ripe tomatoes to-day, September 13th. We have also had lettuce, peas, beans and parsley." These facts are important as shewing that successful agriculture is possible even as far north as the Great Clay Belt.

Besides establishing four new stations we have made an important addition to our meteorological equipment at the O. A. College, viz: an anemometer and an anemograph, the former to measure the wind, the latter to record the measurements. Referring to the records made by the instruments we are able to tell the velocity of the wind in miles per hour at any instant in the day or for any portion of it.

Table V. will give an idea of the wind velocities throughout the year. The highest record for any whole hour was 45 miles. In some cases there were short gusts of much greater velocity, reaching as high as 100 miles per hour for a minute or so.

TABLE V. WIND RECORDS AT GUELPH.

	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total 10½ mos.
Miles of wind during month	4,482	9,263	10,636	9,422	5,013	5,976	6,031	5,231	5,002	9,102	11,287	81,445
Number of days	15.5	30.9	29.2	24.0	21.0	30.0	30.5	26.0	21.0	30.0	31.0	289.1
Average per day	289.1	300.0	364.3	311.9	238.7	199.2	197.7	201.2	238.2	303.4	364.1	281.7
Average per hour	12.0	12.5	15.2	13.0	9.9	8.3	8.2	8.4	9.9	12.6	15.2	11.8
Windiest day, miles	470	640	756	487	398	462	339	484	407	707	688	756
(1) Per hour	19.6	26.7	31.5	20.3	16.6	19.2	14.1	20.2	17	29.5	22.2	31.5
(2) Windiest hour, miles	25	44	39	27	27	27	26	27	25	41	37	44.0
(3) Least windy hour, miles	10	13	20	18	5	10	3	17	12	20	20	20.0
Calmest day, miles	129	48	151	134	148	77	52	59	100	65	133	48.0
(1) Per hour	5.4	2.0	6.3	5.5	6.2	3.2	2.2	2.5	4.2	2.7	5.5	2.0
(2) Windiest hour	11	5	11	10	10	7	7	7	8	9	9	5.0
(3) Calmest hour	3	0	3	1	3	0	0	0	0	0	0	0

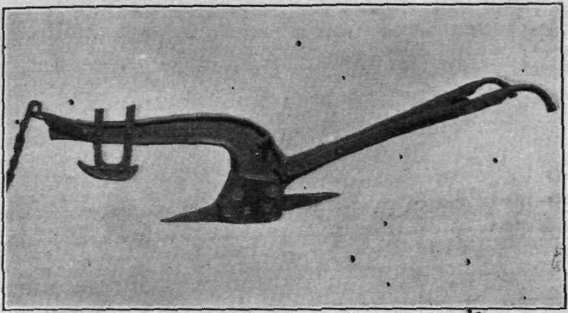


FIG. 1. The Pick Plow (see page 51).

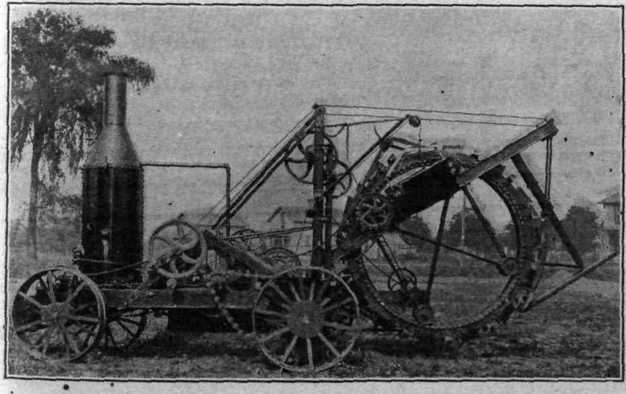


FIG. 2. Ditching Machine. Wheel elevated, ready for travel. (See page 52.)

FIG. 3. Ditching Machine in operation. (See page 52.)

Lightning Report.

Reports of damage done by lightning have been collected this year as previously. The results are given in tables VI. to IX.

Table VI. Buildings Struck in 1908.

How reported.	Barns.				Houses.				Others.			
	Burned.	Damaged.	Totals.	Loss.	Burned.	Damaged.	Totals.	Loss.	Burned.	Damaged.	Totals.	Loss.
				$ c.				$ c.				$ c.
Personally......	12	3	15	29,817 50	1	4	5	1,086 50	....	4	4	180 20
Newspapers	17	2	19	*37,768 77	2	6	8	*1,738 40	....	4	4	*360 40
Totals	29	5	34	67,586 27	3	10	13	2,824 90	....	8	8	540 60

* Loss at same rate as on those personally reported.
Total loss on all building $70,951.77.

Table VII. Other Information Regarding Barns.

Barns personally reported.

Windmill.		Distance from railway.	
Mill on or near........................	3	1-80 mile..............................	1
No mill................................	10	1-11 "	1
Not specified..........................	2	½ "	2
		1 "	2
Location.		2 "	1
		3 "	1
On hill................................	3	3½ "	2
On knoll...............................	3	4 "	2
On plain...............................	5	6 "	1
In valley..............................	2	Not specified..........................	2

Table VIII. Animals Struck.

Animals.	In field.	By fence.	Under tree.	In or near building.	Location not reported.	Totals 1908.	Totals 1901-1908.
Cattle..........	1	....	3	1	25	29	251
Sheep...........	....	1	....	....	....	1	138
Horses..........	1	....	....	1	....	2	73
Pigs............	....	....	....	1	....	1	22

Table IX. Summary of Trees Struck from 1901-1908.

Year.	Elm.	Pine.	Oak.	Maple.	Apple.	Basswood.	Poplar.	Ash.	Willow.	Hemlock.	Cedar.	Balsam.	Spruce.	Chestnut.	Hickory.	Birch.	Cherry.	Beech.	Butternut.	Fir.	Walnut.	Pear.	Thorn.	Total.
1901-1907.....	40	25	15	10	8	7	6	5	5	4	4	4	4	2	2	2	..	1	1	1	1	1	1	149
1908...............	..	..	1	2	..	..	..	..	..	1	..	..	..	..	..	..	2	..	..	..	..	..	..	6
	40	25	16	12	8	7	6	5	5	5	4	4	4	2	2	2	2	1	1	1	1	1	1	155

The number of buildings reported this year is only about half the number last year.

None of the buildings personally reported were provided with lightning rods, though one house had an iron ladder which the claims adjuster says saved the building from destruction.

We sometimes hear it claimed that windmills are dangerous, sometimes that they are a protection. From reports we cannot conclude either way, for taking the country over, many more barns are without mills than with them, likewise most of the barns personally reported have none.

With regard to location we sometimes hear it claimed that an elevated spot is more likely to be struck by lightning than is a low one. Yet it is a curious fact that last year the number of barns reported as being situated on a *plain* was more than double the number on either hill or knoll, greater indeed by one than on both hill and knoll combined. This year again the number on a plain is greater than either on a hill or a knoll, and less by one than the two combined. Hence taking the two years' reports together the number situated on a plain is exactly equal to the number on hills and knolls combined. We have no statistics as to the classification of barn sites in Ontario, but we know that a knoll, hill or hill-side is usually chosen if available. We know also that many portions of the country are very flat so that there is no choice in the matter of site—the barns have to be built on the plain. On the whole I would think that the number of elevated sites about equals the number of sites on the level. If this estimate is correct then our reports would seem to show that neither class of site is more favourable to lightning stroke than the other.

None of the buildings reported are very far from railways, yet no great percentage of them are so close as to indicate that proximity to railway is a source of danger as sometimes claimed.

Last year the number of persons reported as being struck was 21, of whom 6 were killed. This year the number is 27, of whom 11 were killed.

DRAINAGE.

Surveying and Demonstrations.

The drainage campaign carried on by this department for the past four years has been continued this year, and extended. Throughout this work we have been conscious that its most valuable aspect was not the material assistance given to the individual whose farm we surveyed, but the educational influence upon the community, first of a man with a thorough knowledge of drainage operations, and second of a practical illustration of the benefits of drainage, a farm or a field noted for its poor crops transformed by drainage into one equally noted for good crops. To increase the educational value of the work we have this year held a Drainage Demonstration, a field meeting to discuss drainage in all its aspects, in each community where we have done surveying. The demonstrations have in the main been well attended, the number sometimes reaching 50 and over, though occasionally owing to local conditions, or the business of the time the attendance was small. Frequently the neighbors from the farms lying adjacent to the one being surveyed would come at the beginning of the survey and remain throughout. This of course is the best kind of demonstra-

tion, for these men not only grasp the details of the survey, but ask and receive answers to numerous questions about the construction of drains and the way in which they produce their beneficial effects.

The value of this work to the farming community is shown in two ways, first by its growth in popularity:

In 1906 we had 15 applications and made 15 surveys.
In 1907 we had 126 applications and made 70 surveys.
In 1908 we had 166 applications and made 100 surveys.

We have had applications this year from every county west of Peterborough and from several east, making 30 in all, and we have made surveys and held demonstrations in twenty-five of these. Second, by increased interest in drainage, a practical illustration of which is to be found in the vicinity of the Horticultural Experiment Station at Jordan Harbor. Three years ago scarcely a man in that locality was underdraining. We surveyed the farm at the Station and a complete system of underdrains was put in during 1907. Now nearly every man in the locality whose land is too wet is either underdraining or preparing to, so great was the transformation in the Rittenhouse farm. The same thing is being enacted in the various districts where the seed sown has had time to bear fruit. The benefit arising from two or three hundred such centres of influence must in the aggregate be very great. Every acre of land drained becomes at once more productive, the increase in crops ranging from 10% to 100% or even more, depending on how badly drainage was needed, the average increase being probably from 25% to 50%.

To help the department to meet the largely increased demands upon its services a special appropriation of $1,000 was voted by the Legislature by means of which we were enabled to engage extra men for the work. The men employed were as follows:

J. H. Hare, B.S.A., for part of summer.
D. A. MacKenzie, B.S.A., for balance of summer.
W. R. Reek, O. C. White, Associates, O.A.C., for entire summer.

The first three were engaged in survey and demonstration work and Mr. White in drafting. In addition to these four, either Mr. Thom or I was in the field too, the other remaining at the department to conduct the correspondence and lay out routes for the field men. The services of these extra men have been highly satisfactory both to the department and to the people served as shewn by the numerous commendatory letters received.

Drawbacks to Ditching Operations.

The greatest drawbacks to ditching operations in Ontario to-day are the scarcity of labourers, the slowness of the pick and shovel method of digging, and the reluctance of old-time ditchers to adopt improved methods. In most soils and in average seasons it is only for a short time in spring and fall that the spade alone is equal to the task of digging a trench for tile. At other times the pick would have to be used and this would make the digging cost so much more than in spring and fall, that during July, August and September, the finest months of the year for ditching operations, they are at almost a complete standstill throughout the Province. Now this trouble might be overcome by the pick-plow, an illustration of which is shown on page 47, Fig. 1.

During the past summer Mr. W. D. Breckon, manager of the Osler farm at Bronte, Ontario, installed twenty-two miles of tile drains. The pick-plow was used most of the time, but occasionally it was not, and then the pick was used. It was found that a gang of Italians using pick and

shovel could dig 3 rods per man per day, but the same gang using the pick-plow could dig 4¼ rods per man per day, or 41⅔ per cent. more than with the pick and shovel. Hence if the pick-plow were generally introduced into ditching operations it would materially lessen the cost of digging, and even in the middle of the summer by its use drains could be dug at the prices now paid for spading in spring and fall. But the orthodox ditcher objects to using anything but the spade and occasionally the pick and shovel. Another factor that stops ditching operations in summer is the lack of water to dig by. In Essex County, for example, the ditching is nearly all done by the old fashioned method of having water in ditch by which to determine the grade. This can be had only in spring and fall. Thus for months ditchers in that county are lying idle, while the farmers are anxious to have the work carried forward. Now, the "over-head line method," which was described in last year's report of this department and which is fully described in our "Farm Drainage Operations" pamphlet which we have for distribution, is just as accurate as the water method, and may be used when the land is dry as well as when it is wet. We would commend it to the consideration of any one intending to do ditching.

But even if all the ditchers in Ontario were to use up-to-date methods and work all the summer through, they would not be able to do all the ditching now contemplated, and which the farmers have not time to do themselves. Where there is a large amount to be done, as at the Horticultural Experiment Station last year (11 miles) or at the Osler farm at Bronte this year (22 miles) it is feasible to put on a large gang of Italians, engaging a competent man to oversee the work. The operations may then be carried forward rapidly but the cost is somewhat greater than if done by a few, for the gang does not accomplish as much per man per day as an individual workman where only a few are engaged.

Ditching Machines.

All these drawbacks making themselves felt in various parts of the Province have led to the frequent enquiry "Is there any machine that will dig these ditches satisfactorily." Until recently we have had to answer this question in the negative, for although we heard of several ditchers being tried there was some drawback to them all. Some time during the autumn, however, it was reported to us that Mr. Jacob Schihl, of Woodslee, Essex County, had a ditcher that was giving satisfaction. Accordingly I went to see it working, taking a surveyor's level along to test the grade left by it. I watched it carefully for two and a half hours, or one-quarter of a day. In that time in very heavy clay it dug 30 rods of ditch full depth in one transit over the ground leaving the most beautiful ditch bottom I ever saw. This is equal to 120 rods a day, not allowing for laying out ditch. It averages from 90 to 100 rods a day, I am told, including all stops and the laying out of the drain. It is a traction machine and is operated by two men. Figure 2 shows the ditcher (see pages 47 and 48) all ready for travel. Figure 3 shows it in operation. In the hands of a careful workman it digs true to grade no matter what the unevenness of the ground traversed, leaving the ditch bottom ready for the tile. The price charged by Mr. Schihl per lineal rod was 7 cents for each foot in depth; that is 17½ cents a rod for a ditch 2½ feet deep and 21 cents a rod 3 feet deep, the farmer supplying the fuel and boarding the men. The fuel amounts to about 2 cents a rod if he has to buy it, but around a farm there is usually considerable refuse which may be burned, thus reducing the outlay for fuel to practically nothing, and the board of two men and one horse amounts to 1½ cents a rod, mak-

ing the total cost of a 2½ foot ditch 21 cents and of a 3 foot ditch 24½ cents. Digging by hand and plow in that same heavy soil, would cost from 40 to 50 cents a rod 3 feet deep, and even in the lightest soils about 25 to 30 cents. Hence if a few of these machines were introduced into Ontario and ditches dug at the same price as in Essex the price of underdraining would be reduced very materially. Where there are stone to contend with the price would be somewhat higher than in Essex.

Being so favorably impressed with this machine, which is a 1905 model, I visited the manufacturers, the Buckeye Traction Ditcher Co., of Findlay, Ohio, to see the later types. These are improved in many details. There I saw one digging 5 feet per minute, or 180 rods per day, and the manager made the proposition that they would dig 7 feet a minute or 252 rods a day on condition of selling the machine. In Ohio in prairie soil the price of digging is 10 cents a rod for the first two feet, and half a cent an inch thereafter, making a 3 foot ditch cost 16 cents for digging, a total cost of 19½ cents a rod when the price of fuel and board is added. This is very cheap ditching. Of course we could not expect so low a rate in Ontario, for the duty on a machine being imported is about 30 per cent. and the freight is considerable. The price of the ditcher varies with the size. The smallest, cutting a trench 11½ inches and any depth down to 4½ feet, costs $1,200, f.o.b. Findlay. The next size 14½ inches x 4½ feet, $1,400, and the next 15 inches x 5½ feet, $1,700, special steel machine of third size for stony ground, $2,400. Much larger ones are made for contract work. I saw one capable of cutting a trench 26 inches wide and 10 feet deep, another 42 inches by 7½ feet and others for digging open ditches with sloping sides. Mr. Schihl, whose machine is of the smallest size, says he would buy a larger one again, because it is built stronger, and will handle stones better. Personally, I would favor the third size for the two reasons already given, and also because occasionally one must, in going through a knoll, go deeper than 4½ feet, which of course the first two cannot do.

The mention of stones suggests the query whether the machine will work in stony land. The College of Agriculture at Cornell University, Ithaca, has the special steel machine equipped with rooters and steel cutters to enable it the better to handle stones. Prof. Minns writes me that it has given good satisfaction even where numerous stones occur. Of course the speed is slower, and sometimes it is necessary to raise the digging wheel and dig out a large stone by hand. Smaller ones are elevated by the machine. In *very* stony land the company does not recommend it; such land, however, is not drained as a rule. Prof. Minns states that in good land their machine is perfection.

I have written this lengthy report in the hope of interesting some one in various parts of the Province to the extent possibly of investing in one of them and then doing ditching in their vicinity as Mr. Schihl is doing in Essex. Mr. Schihl states that he could be busy all the time with it if his other duties would allow him. The outlay would be $1,500 to $3,500 depending on the size and type of machine, and the earning power along with two men $18 to $21 a day at present Essex prices. Query: "How long would it take to pay for itself? How much longer would it last?" For anyone in a position to undertake it, wouldn't this be a good investment? Of course one would have to run the risk of not being busy all the time.

One other point should be mentioned, viz.: that one of the two men with a machine should have some knowledge of levelling and determining grades and in fact drainage surveying in general. Some knowledge of the theory of drainage would be helpful too.

I am strong in the hope that more of these machines will be introduced into Ontario in the near future, thereby bringing a solution of some of the difficulties with which the farmer doing draining finds himself confronted.

Cement Tile.

We have had many enquiries as to the cost of making cement tile, so we determined to make some in order to inform ourselves on the point and enable us to answer the question. We wrote the London Concrete Machinery Co., of London, Ontario, telling them our purpose and they kindly donated to the department one of their tile machines, and with it our tests were made. Mr. A. M. Shaw, a third year student, who has had considerable experience with cement and who is investigating some phases of drainage for his Fourth Year thesis, made the tests for us, so that the work was done by an experienced man.

Some difficulty was encountered at first in getting the mortar of the right consistency. It must be wet enough that the tile will make the "initial set," yet dry enough that they will lift off the moulds without sticking. The wetter they can be made and yet come away *smooth* the better the cement. At first to get them to come off right we had to mix the mortar so dry that onlookers vowed the tile would "never set," but they did, provided they were kept shaded so as to remain moist for about a day. If exposed to the hot sun or a drying wind or both during the first few hours they dried out too quickly and would never make good tile. Water is essential to the proper setting of cement. By oiling the moulds, however, we found that the mortar could be made fairly wet and yet the tile not stick, but come off smooth and perfect in shape. Still the mortar was far from what is known as "slush" and hence there was not in it enough water to make good cement, and it was found that the direction accompanying the machine to "keep the tile moist for one week after making" was a very essential part of cement tile manufacture. On no account should this direction be violated.

The proportions of sand and cement is a matter of choice. The directions say 7 to 1, but we used mostly 6 to 1. Either makes a tile strong enough to withstand all the pressure to which it will ever be subjected. As to durability we are not in a position to speak from actual test but very energetic investigations are being carried on at several experiment stations in the United States to determine the life of cement tile. Montana has hewn (Bulletin 69) that alkaline water in the soil will bring about the disntegration of cement tile in a few years. This week I am in receipt f a pamphlet published by Brick, of Chicago, giving results of investigaions carried on by Messrs. G. G. and A. J. Wheat, of Emmetsburg, Ia., ssisted by Dr. Nicholas Knight, chemist, of Cornell College, Mt. Vernon, a. These gentlemen give what appears to be indisputable evidence that ioroughly cured cement tile six months old, 1-5 cement and hard and trong almost as a clay tile is soluble in water, so much so indeed that at ie same rate all the cement in it would be dissolved in about 3 3-5 years. n ordinary soil water it was a little less soluble. Hence with water connually passing through the pores (cement tile is very porous) the tile in ie drain must in a few years reach the point of disintegration, much as a ft stone crumbles. They also claim that acid soils are especially destrucve of cement tile. I am also in receipt of a booklet, published in Detroit, ntitled "Cement Tile," devoted to the refutation of the arguments set forth the Brick pamphlet. It claims that Messrs. Wheat's investigations have

been limited, and biased, and moreover their own figures show that the rate of solution drops off rapidly, that only a small portion of the cement is soluble, and that hence the tile cannot "crumble as so much sand," as Mr. Wheat claims they will. After reading both pamphlet and booklet one is still left wondering whether cement tile will really prove durable. A year or two of investigation should pretty well settle the point.

Now as to cost: Mr. Shaw found that 6 cubic feet of sand and 1 bag of cement (a bag contains approximately 1 cubic foot) would make 78 complete 3-inch tile, say 75, in case a few might be spoiled, and that he could make one "batch" in 1 hour and 25 minutes, doing all work himself. At this rate he would make 546 complete 3-inch tile in a day, at 78 tile per batch, or 525 at 75 per batch. With these facts to work with and knowing the price of materials in his own locality any man in Ontario can calculate for himself at what cost he can make cement tile.

The hauling of material may be offset against the hauling of clay tile, so that arriving at a comparison between the two this factor may be omitted. Let us "figure" on a day's work for one man. 525 tile—7 batches,—approximately. Therefore 7 bags of cement, or 1¾ barrels are needed and 7 times 6 cubic feet or 42 feet of sand, or about 1½ yards of sand. Hence for one day's work the outlay would be:

1½ yards sand at 8 cents	$ 12
1 day's wages at $1	1 00
1¾ barrels cement at $1.90	3 33
Total for 525 tile	$4 45

At this rate 1,050 tile would cost $9.90 and 1,000 tile $9.33. The prices quoted by the gentleman are lower than can be obtained in Guelph, and they are probably lower than in many other parts of Ontario, but as pointed out before the reader can use the prices prevailing in his own district and determine the cost of making this kind of tile. And if he finds that he can make the tile cheaper than clay, then he must consider whether the difference is sufficient, and whether he needs enough tile to pay him to go to the expense of buying a tile machine. This first cost, as well as some other details, may be best answered by reference to the instance now about to be given.

In the early summer one of our field men made a survey for Mr. Clarence Abbott, of Cultus, Ontario, some fourteen miles south of St. Thomas. He found Mr. Abbott with a complete outfit and making his own tile in large quantities and on his return reported the matter to me. In the autumn, in order that I might have some information from the practical side, as well as from our own laboratory tests, I wrote Mr. Abbott asking him a long list of questions which he very kindly answered. I give the questions and answers below:

1. Q. What did your machine cost? A. My machine is a London and cost $170 with four outfits and 100 pallets.

2. Q. For what sizes is it equipped? A. Eight inch, six inch, four inch and three inch.

3. Q. What number of pallets of each size, and the cost thereof? A. 20 8-inch, 30 6-inch, 30 4-inch, and 20 3-inch. All pallets cost 50 cents each.

4. Q. What preparation in the way of platform, shelter, etc., did you make, and what was the cost thereof? A. I made a platform 10 ft. by 14 ft. of brick laid flat on the ground on which I mix the concrete and operate the machine. All the shelter required is something to keep the sun off while you are working. I used a tent cover which I happened to have. I made racks

to hold pallets while tile are curing sufficient to hold 100 pallets by setting posts 2 ft. apart and 2 ft. above ground and nailed boards on inside along the top. This saves a lot of stooping work and keeps the tile from being broken while green. The most essential part is to have a good supply of water elevated enough to sprinkle through a hose. For this purpose I used three barrels connected together by means of short pieces of hose and placed on platform 8 ft. high and forced the water with a windmill. The cost of my plant did not exceed $25.00.

5. Q. What strength do you make your mortar? A. Seven parts sand to one of cement.

6. Q. How many complete 3-inch tile can you make from one bag of cement? A. I cannot tell exactly as I have not pallets enough to test it, but I think about 125.*

7. Q.—What does your cement cost? A.—$2.00 per barrel.

8. Q.—The cost of your sand? A.—I used mostly pit gravel sifted, which cost 15 cents per load at the pit. I also used lake or beach sand, which I like better, but it was too heavy to haul.

9. Q.—What number of men do you find economical to operate the outfit? A.—Two, one to mould and the other to wait on him.

10. Q.—The cost of labour per day? A.—$1.00 with board.

11. Q.—How many 3-inch tile per day can your men make if working steadily on that size? A.—600.

12. Q.—What is your estimate of the cost of your tile compared with the cost of clay tile? A.—Two-thirds to three-quarters the price of clay tile.†

Before leaving the subject of cement tile, I should like to say that while the question of durability of cement drain tile is being settled, and while cement tile machinery is being perfected, it might be as well for Ontario farmers to go slowly in the matter of adopting cement tile.

Drainage Law.

This year as in the past several drainage disputes have come to our notice, through correspondence and otherwise. Almost invariably these arise from ignorance of the Ditches and Watercourses Act or from a deliberate determination to disregard the rights of others and "bluff" those wanting the drainage into abandoning the proposed ditch rather than "go to law" to force an outlet, or into constructing the ditch themselves rather than try to compel those "up stream" to come down and pay their just share for outlet privileges. For instance, one man declared "I won't let a drain go through here if it costs the farm." If it is the natural course of the water he might as well try to fly as to prevent the drain being built, or escape paying his share, if it benefits his land, if the proper steps are taken to force the outlet. Only a person ignorant of the law or deliberately unjust and stubborn would make such a declaration. It is equally futile and unfair for a man living up stream to declare that he will not assist with the outlet, provided he lives within statutory distance of the sides or point of commencement of the drain.

Amendments to Ditches and Watercourses Act.

In this connection it may be wise to draw attention to what that distance Up till last session of the Legislature the owner of any lands lying

* The estimate of 125 is probably a little high. At 6 parts of sand to one of cement made 78 tile from one bag, and at 7 to 1 the number would be approximately one-th more, or 91.

† This estimate does not differ greatly from the calculation made on the prices at grave.

"within 75 rods of the sides or point of commencement of the drain" and which land drained into that course could in case an engineer was "brought on" be assessed for outlet benefit. (R.S.O. ch. 285, sec. 6 (1)). The Legislature of 1908, however, amended this section to read 150 rods instead of 75, so that now any owner having land within approximately half a mile of the sides or point of commencement of a drain may be assessed for the construction of the same if this land slopes toward the drain. This, I believe, to be an improvement in the Act, for in many cases 75 rods was insufficient to do justice to all concerned.

Defect in Ditches and Watercourses Act.

There is another glaring defect in the Ditches and Watercourses Act, viz., that an engineer is not compelled to make a report if he finds the drain unnecessary. Section 16 (1) of the Act reads: "......... *and if he finds that the ditch is required*, he shall .... make his award..........." In no part of the Act is he instructed what to do in case he finds that the ditch is not required. This leaves a beautiful "loop-hole" for unscrupulous neighbours and engineers, if such there should be. From the engineer's standpoint there is an equally objectionable feature related to this, viz.: if he does not make an award the Act provides no means whereby he can collect his fees for the time spent. In the possible case alluded to above this would not be serious for it would be an easy matter for unscrupulous men interested in blocking the proceedings to see that the engineer did not lose by finding that "the ditch is not required." But there are cases, and I know of such, where in all honesty after a preliminary survey the engineer finds that for some reason the ditch cannot be proceeded with. He makes no award because he cannot, nor any report, for the Act does not call for one. The petitioner is dissatisfied because his ditch is being held up without apparent reason, or may be he thinks some underhand work is being done, while the engineer has a grievance in that he has been caused a considerable loss in time and possibly in money (for livery and assistant may be) with no provision for his reimbursement. It seems to me therefore that the Act should be amended in these two particulars: (1) Should the engineer find that the ditch is not required he should be bound to bring in a report to that effect, the party concerned being given the right of appeal against such report as against an award; (2) Provision should be made for the payment of the engineer's fees in case of a report as in case of an award.

Financial Assistance in Under Drainage.

Frequently we meet men whose land needs underdrainage very badly, and who because of scant crops given by the over-wet land are not financially in a position to underdrain, much as they would like to. For the assistance of such, provision has been made in the Tile, Stone and Timber Drainage Act (R.S.O., chap. 41). By this Act any municipality in Ontario is empowered to borrow from the Consolidated Revenue Fund of the Province for drainage purposes sums of money ranging from $2,000 to $10,000. It is further empowered to lend this money out to farmers at 4% compound interest in sums ranging from $100 to $1,000 to any one man in $100 lots (no fractions) to be used in draining their land by tile, stone, or timber drains. The township may borrow not less than $2,000 for these purposes, and may lend not more than $1,000 to one man, hence two or more farmers must apply before the council can proceed. The money is to be repaid to the township in twenty equal annual payments of $7.36 for each $100 borrowed. To gain

a better idea of what this charge would mean to the land drained we may reason as follows: $100 will on the average pay for the drainage of about 5 acres of land, hiring everything done. The charge per year would be $7.36 on five acres or $1.47 per year on one acre. Now if the drainage increased the crop only 10%, a very low estimate, that on a crop of wheat would mean 2 bushels per acre, and this would pay the $1.47. As a matter of experience by hundreds of farmers who have drained extensively we are able to state that the increase in crop is much more than 10%, enough indeed, to pay the entire cost of drainage in from two to three years (three years is the longest estimate I have had from any of those whom we have interrogated on this point). Such being the case would it not be good business for any man who wants to drain but hasn't the capital to find some one or more others in a like position and they together make application to the council for loans under the Tile, Stone and Timber Drainage Act? The first man for whom the writer did drainage surveying was a man who had some years earlier availed himself of the aid offered by this Act, and he was enthusiastic in advocating such action. He is a man who with little capital bought a wet farm in one of the best of the many good districts of Ontario, and who as almost a first step drained it as indicated. To-day he is well-to-do.

Investigations.

Under this heading we have no work of our own to report. The drainage proposition seemed so important and the time seemed so opportune for an energetic prosecution of the campaign to spread throughout the Province a more general knowledge of farm drainage operations that our research work in poultry, evaporation, transpiration, soil moisture and soil aeration have been sacrificed for the time being. This we regret very much; we believe these various problems are important and we submit that our staff should be increased by one man in order that we may follow up these investigations. But while we have no investigations of our own upon which to report, some thesis work has been done under our supervision that we deem highly important, and upon which we have prepared reports. One of these has already been referred to, viz.: the cost of making cement tile. The other is that of ventilation, a report of which follows.

Muslin Curtain Ventilation vs. Massey System and King System.

Owing to the general discussion of the Muslin Curtain system of ventilation and the lack of definite information regarding the same, it was deemed advisable to conduct an investigation into the relative merits of this and the systems already in use at the College. It was the original intention to have this work done by one of the staff of the department, but it was seen in advance to entail a great amount of labor at a time when the department was already taxed beyond its limit with teaching duties. Hence it was turned over to Messrs. H. Sirett and H. C. Duff for thesis work under the close supervision of the department of Physics.

It was intended to start the work January 1st, but it was found that the Christmas holidays, although occupied largely in preparation, were not sufficiently long to have everything ready. Besides getting the curtains in readiness these men made a careful study of gas analysis, in so far as carbon dioxide determination is concerned, so that it was the end of January before actual observations were begun.

There are two cattle stables at the College, the "farm" stable in the main barn, and the "dairy" stable at the dairy barn. The former, which has since been remodelled, was originally ventilated by a modification of

the Massey system. Cowls above the peak, always turning their open side toward the wind except it was a gentle one, provided the intakes for the fresh air. From them large flues led down to the stable beneath, one for each feed passage between two rows of cattle, and dividing into two branches along the manger on each side of the passage, with a 3 inch auger hole in front of each stall. Thus, when fresh air came down the flue, a portion of it was discharged from each hole, each animal then getting its fair share. The foul air was supposed to be discharged from the ceiling through outlet flues which led up into the body of the barn. There were two outlets, and two inlets branching to four. The system did not prove at all times reliable, for frequently the intended inlets were found by actual test to be outlets and the air movement in the intended outlets was always sluggish. But such as it was we decided to test it against the muslin curtain system.

The dairy stable was and still is ventilated by the "King" system. The intake for the fresh air is near the ground, but instead of the air being admitted at this level it is led up inside the wall to the ceiling through inch-board flues, about 8 inches by 10 inches, some of which open into the stable at the side wall, while others continue along the ceiling to the centre before opening into it. All the fresh air is thus admitted at the ceiling, whence it sinks to the floor, distributing to all parts as it does so. The outlet flues are also at the side walls. Beginning at the floor they pass up the wall through the ceiling to the eaves, whence they run along beneath the roof to the peak where in twos (one from each side) they unite in small ventilators through the roof. Down in the stable most of the outlet flues are provided with two openings, one near the floor and the other at the ceiling, each having a door, so that the outgoing foul air may be drawn from the floor or ceiling as desired. There are 6 inlets and 8 outlets, 5 of the outlets extending to the floor. Consulting the tables which follow, the reader will observe that in both stables the air at the ceiling was always from 3 to 5 degrees warmer than that at the floor. Hence the purpose of the two outlets in the King system is obvious. During moderate or mild weather, when the stable is likely to become too warm the ceiling outlets may be used, the warm air drawn off and overheating prevented. In severe weather when the stable is likely to become too cool, the floor outlets may be used, the cold air is drawn off, and the proper temperature again maintained. Usually the floor outlets were used.

In summing up the systems, then, they are as follows:

Farm stable, Massey system, fresh air admitted at floor; foul air drawn from ceiling. Dairy stable, King system, fresh air admitted at ceiling, sinks to floor; foul air drawn off at ceiling in mild weather, at floor in severe weather. Thus in mild weather the two systems are similar in principle, though differing somewhat in details. In severe weather the systems are directly opposite in principle.

The farm stable was 126 x 52 x 10½ feet, and contained 45 cattle, thus having 1,550 cubic feet of space per head. The dairy stable was 120½ feet x 38 feet x 8½ feet. It contained 38 cattle, each thus having 1,024 cubic feet of space. Hence it will be seen that the dairy stable afforded only two-thirds as much room per animal as did the farm stable. The latter had 12 windows on the south-east side, half double sash, one part of which could be slid sidewise thus leaving the window half open. All were covered with cheapest cotton ("muslin curtain"). The dairy stable had two windows on the south-east side, ten on the north-west, one on the north-east end and two on the south-west, making 14 altogether. Of these 7 were fitted with muslin curtain, 4 on north-west, 1 on south-east, and 2 on south-west.

They were hinged at the bottom, and could be opened little or much as desired. When partly open they directed the incoming air upward.

It was the plan of the experiment to test first the systems already installed in the stables and then to close the inlets and outlets and open part or all of the windows covered with the muslin curtain and test the muslin curtain system. The ultimate test of the efficiency of any system is the degree of purity of the air in the stable. And since the purity or impurity of air vitiated by breathing is generally stated in terms of its carbon dioxide content we decided to adopt that as one standard of comparison, and throughout the months of February and March, 1908, carbon dioxide readings were taken at the floor and ceiling and occasionally part way between. The relative humidity, i.e., the amount of moisture in the air in terms of its total moisture capacity at that temperature, was also read at the floor and ceiling. In adition to these data the maximum and minimum temperatures for the night both outside and in the stable were observed; also the floor and ceiling temperatures at the time the carbon dioxide determinations were made, all "floor" readings being interpreted to mean level with cattle's nostrils (average position). But our information would not be complete without one more factor. It is known that the wind exerts a potent influence on ventilation, and in order to have accurate determinations a complete wind-recording outfit was installed. From the daily records of this "anemometer" we are able to tell for any minute in the day the direction of the wind and its velocity in miles per hour. Consulting the records these facts for the times at which readings were taken have been entered in the tables.

One other test was made, the readings for which are not here recorded. The velocity of the air in the inlets and outlets was frequently measured, the instrument used being a delicate anemometer, so delicate indeed that at a distance of twelve feet its wheel can be made to turn by a person blowing at it. This delicate instrument was placed in the flue where air current was to be measured. In calm weather the movement of air through the muslin curtain was never sufficient to affect the anemometer, though with a very strong wind blowing perpendicularly or nearly so on the muslin the air came through at the bottom of the curtain with sufficient speed to turn the wheel slowly. In the King system there were always strong blasts coming in and others going out. In the Massey system the movement through the "outlets" was only sufficient at the greatest to turn the wheel very slowly, sometimes not at all. In the "inlets" which sometimes acted as such and sometimes as outlets and sometimes alternated every few minutes, the movement was usually rapid. These readings would seem to indicate that it is not a good plan to have the "outlets" open into the body of the barn, but that they should be continued above the roof.

Where there are so many people going in and out of stables as there are here it is only at night that ventilation systems can be properly tested, and so readings were always taken at night, being begun from 9 to 10 p.m. as a rule and frequently continued till midnight and occasionally later, for carbon dioxide determination is a slow process. For each stable the observations were taken about 25 nights. Mr. Sirett was in charge at the main barn and Mr. Duff at the dairy barn.

Table X gives the data for the farm stable. Looking first at the carbon dioxide content, we see that in the first test of the Massey system there were at the floor 11.1 parts of carbon dioxide by volume in 10,000 volumes of air; at the ceiling 15.4 parts. Air in its "pure" state contains about 3.3 parts per 10,000. The readings during this test seem very irregular, sometimes high and sometimes low. In one point five out of the six readings agree, viz: shewing more CO_2 (carbon dioxide) at the ceiling than

System.	Date (1908).	Wind. Direction.	Wind. Velocity—Miles per hour.	Temperature. For night. Outside. Max.	Outside. Min.	Inside. Max.	Inside. Min.	At time of reading. Outside.	Inside. Floor.	Inside. Ceiling.	Humidity. Floor.	Humidity. Ceiling.	Carbon Dioxide. Volumes in 10,000 volumes air. Floor.	Ceiling.	Adjustments. Massey. 4 ceiling outlets.	Massey. 4 floor inlets.	Muslin Curtain. Windows in use.	Remarks.
Massey System. First Test.	Jan. 30	......	Str.	8.0	-2.0	Maximum and minimum readings taken six feet from floor.		....	32.5	....	95.7	....	13.3	21.2	open	cl's'd	......	Inlets packed with straw.
	" 31	......	......	20.0	12.0			20.0	34.0	....	79.2	....	17.8	23.4	"	"	......	Inlets packed with straw.
	Feb. 1	N.E.	......	28.0	24.0			12.0	39.0	....	81.6	....	....	....	"	open	......	Whenever tested with the anemometer the outlets showed little air movement and inlets showed erratic movement.
	" 3	......	C.	8.0	-19.0			-5.0	36.0	....	80.2	....	7.8	5.6	"	"		
	" 4	......	C.	12.0	-11.0			-10.0	28.0	....	88.0	....	13.4	25.7	"	"		
	" 5	N.E.	Str.	27.0	16.0			27.0	35.0	....	83.5	....	7.3	7.8	"	"		
	" 6	......	Str.	25.0	11.0			12.0	37.5	....	86.0	....	6.7	8.9	"	"		
	Averages	......	......	18.3	4.4			9.3	34.6	....	84.9	....	11.1	15.4	......	......		
Muslin Curtain. First Test.	Feb. 13	......	Str.	38.0	35.0			36.7	50.0	....	92.7	....	16.7	21.2	......	......	6	Windows 44 in. x 26 in. all on S.E.
	" 14	......	......	36.0	28.0			33.0	48.5	....	88.9	....	....	....	......	......	......	Windows sheltered on east and west by wings of stable.
	* " 15	E.	9	18.0	13.0			21.7	47.5	....	88.6	....	16.2	14.5	......	......		
	" 17	E.	6	17.0	16.0			10.0	42.0	....	91.4	....	....	....	......	......	......	Odor.
	" 18	N.E.	17	14.0	10.0			20.5	40.5	....	82.2	....	14.5	17.8	......	......	......	Odor.
	Averages	......	......	24.6	20.4			24.4	45.7	....	88.8	....	15.8	18.2	......	......		
Massey System. Second Test.	Mar. 5	E.	21	38.0	36.0	48.0	42.0	....	42.5	....	78.9	....	10.6	11.2	open	open		
	" 6	S.W.	40	38.0	33.0	46.0	45.0	....	44.0	....	75.6	....	6.1	7.2	"	"		
	" 7	S.W.	10	36.0	28.0	48.0	46.0	....	45.1	49.6	76.8	82.7	6.7	9.5	"	"		
	" 9	S.	10	33.0	23.0	45.0	42.0	....	41.2	45.9	85.9	84.9	6.7	8.9	"	"	......	Inlets all acting as outlets.
	" 11	S.W.	6	37.0	32.0	50.0	48.0	....	45.2	50.2	90.5	82.9	5.6	8.4	"	"	......	Inlets erratic.
	" 12	E	8	40.0	34.0	52.0	49.0	....	46.4	52.8	89.1	78.4	7.3	7.8	"	"	......	Inlets 1 and 2 acting as outlets. Inlets 3 and 4 acting as inlets.
	" 14	S.W.	17	35.0	26.0	56.0	41.0	....	49.8	53.6	88.4	84.0	7.3	9.5	"	"	......	Inlets 3 and 4 acting as outlets. Inlets 1 and 2 acting as inlets.
	Averages	......	16	36.7	30.3	49.3	44.7	....	*45.4	50.4	*86.1	82.6	7.2	8.9	......	......	Odor.	
Muslin Curtain. Second Test.	Mar. 16	N.	4	32.0	21.0	47.0	41.0	....	45.6	49.0	85.8	82.5	7.2	11.2	......	......	12	6 windows 45 in. x 26 in. and 6 other 50 in. x 26 in. all fitted with muslin and open on S.E.
	" 18	N.E.	12	31.0	27.0	50.0	48.0	....	47.0	50.2	93.9	80.0	7.8	7.8	......	......		
	" 19	S.W.	7	33.0	25.0	51.0	50.0	....	48.2	50.6	89.6	92.8	10.6	9.5	......	......		
	" 20	S.W.	7	31.0	24.0	52.0	46.0	....	49.2	52.8	91.2	86.3	16.7	12.8	......	......	......	Windows sheltered on east and west by wings of stable.
	" 21	S.W.	15	34.0	32.0	52.0	46.0	....	49.0	53.8	85.3	79.7	8.4	9.5	......	......		
	" 23	S.W.	11	33.0	30.0	56.0	51.0	....	54.2	57.8	90.7	86.4	12.8	13.4	......	......	Odor.	
	Averages	......	9.3	32.3	26.5	51.3	47.0	....	48.8	52.4	89.4	84.6	10.7	10.7	......	......		
Averages: Massey	......	......	......	*36.7	30.3	*49.3	44.7	....	*45.5	50.4	*86.1	82.6	9.0	11.9	......	......		
Muslin Curtain	......	......	......	32.3	26.5	51.3	47.0	....	48.8	52.4	89.4	84.6	12.4	13.2	......	......		

* In case of related readings, *e.g.*, "maximum and minimum" or "floor and ceiling," the averages include only the observations when both readings of the pair were taken.

C, Calm; Str., Strong.

at the floor. They were taken during the latter part of a very cold spell during which some difficulty was experienced in keeping the stable temperature above freezing, so much so that for some time previous to the beginning of the test the inlets were packed with straw. This was removed after a few days. It may be explained here, too, that no effort was made by the experimenters to regulate the Massey or King systems. They were tested as in ordinary use by the herdsmen at the respective barns.

Coming to the first test of the Muslin Curtain system in the same stable, with six windows curtained, (96 square feet of curtain) we observe that the averages shew much higher CO_2 content than with the Massey, the greater quantity being at the ceiling as in the Massey, though one of the three individual readings shews more at the floor. The "floor" readings are pretty uniform.

Coming to the second test of the Massey system we find a beautifully uniform set of readings, and all shewing greater carbon dioxide content at the ceiling than at the floor, the amount at the latter being slightly greater than twice the amount in "pure" air. Throughout the test the CO_2 was low. The average wind velocity at the time of reading was high, viz. 16 miles per hour.

In the second Muslin Curtain test with 12 windows curtained, we again see more CO_2 than in the second Massey test, though not so much as in the first Massey test. We see a considerable variation in these readings, but if we look at the wind velocities we find that in most cases the quantities of CO_2 at the floor vary with the wind. Two of the six readings shew the more CO_2 at the floor, three more at the ceiling, and one the same for both, the average being exactly the same for both floor and ceiling. So far as carbon dioxide is concerned more value is placed upon the second test than upon the first, in which the working of the Massey system was somewhat disturbed.

Averaging the readings of both tests we find that at the floor which, as previously explained, means on a level with the average position of the cattle's nostrils and which is therefore the more important, the Massey system gives 9 parts of CO_2 per 10,000 volumes of air and the Muslin Curtain 12.4 parts, the latter being an increase of 37.7 per cent. over the former. In the Massey system the greater quantities of CO_2 are at the ceiling. In the Muslin Curtain the first test also shewed greater CO_2 at the ceiling, but the other test shewed an even distribution, the same at the floor as at the ceiling.

The humidity readings are worth noting. In each test the Muslin Curtain increased the humidity, and all readings are very high, even though the CO_2 content may be low. The stable is thus a damp one, 86.1 per cent. humidity at the floor when ventilated by the Massey system and 89.4 per cent. with the Muslin Curtain. The humidity is greater at the floor than at the ceiling in both systems.

The maximum and minimum temperatures were taken during the second test. Average range for night with Massey system 4.6 degrees, greatest range 15 degrees. The Muslin Curtain gave an average range of 4.3 degrees and a greatest range of 15 degrees. The Muslin averages are the higher in all cases. All the curtained windows were on the south-east side, and the wind was never such as to blow with much strength upon them.

Table XI gives the results for the dairy stable. In the first test the CO_2 readings are pretty uniform with the exception of one at the ceiling, all ceiling readings being greater than corresponding floor readings. What variations occur in the floor readings go with the wind.

TABLE XI.

System.	Date (1908).	Wind. Direction.	Wind. Velocity—Miles per hour.	Temperature. For night. Outside. Max.	Temperature. For night. Outside. Min.	Temperature. For night. Inside. Max. †	Temperature. For night. Inside. Min. †	Temperature. At time of reading. Outside.	Temperature. At time of reading. Inside. Floor.	Temperature. At time of reading. Inside. Half-way.	Temperature. At time of reading. Inside. Ceiling.	Humidity. Floor.	Humidity. Ceiling.	Carbon Dioxide. Volumes in 10,000 volumes air. Floor.	Carbon Dioxide. Half-way.	Carbon Dioxide. Ceiling.	Adjustments. King. 5 floor outlets.	Adjustments. King. 8 ceiling outlets.	Adjustments. King. 6 inlets.	Mus. Curtain. Curtained windows in use. N.W.	N.E.	S.E.	Remarks.
King System 1st Test.	Feb. 3...	N.E.	Li.	8.0	-19.0	56.0	53.0	-5.0	50.0	....	53.0	85.6	.....	13.3	....	13.3	open	cl's'd	1 partially open				
	" 4...	......	C.	12.0	-11.0	54.0	46.0	-11.0	47.0	....	50.0	77.2	.....	10.0	....	13.3	"	"					
	" 5...	......	C.	27.0	16.0	52.0	46.0	20.5	46.0	....	49.0	78.1	.....	11.1	....	20.0	"	"					
	" 6...	S.W.	Str.	25.0	11.0	56.0	52.0	16.0	53.0	....	55.0	79.8	80.5	10.0	....	13.3	"	"	1op'n				
	" 7...	N.W.	Li.	18.0	-7.0	56.0	52.0	7.0	50.0	....	53.0	78.6	79.8	11.1	....	13.3	"	"					
	" 8...	N.W.	Li.	14.0	-2.0	55.0	49.0	-7.0	48.0	....	51.0	70.4	72.2	10.0	....	12.2	"	"					
	Averages	......	....	17.3	-2.0	54.8	49.7	3.4	49.0	....	51.8	*76.3	*77.5	10.9	....	14.2							
Muslin Curtain 1st Test.	Feb. 10...	S.	Li.	25.0	12.0	56.0	50.0	19.0	55.0	....	57.0	80.5	80.9	22.2	....	17.8	.....	.....	.....	2	...	1	Strong Odor.
	" 11...	......	Li.	28.0	25.0	59.0	53.0	28.0	57.0	....	60.0	75.2	82.2	23.4	....	.....	.....	.....	.....	4	....	1	Strong Odor.
	" 12...	......	Str.	30.0	29.0	59.0	53.0	35.0	54.0	....	58.0	73.8	69.8	13.3	....	.....	.....	.....	.....	4	....	1	Odor.
	" 13...	......	Irr.	38.0	35.0	62.0	58.0	37.0	58.0	....	61.0	75.6	82.5	18.8	....	.....	.....	.....	.....	4	....	1	Irregalar current
	" 15...	E.	9	18.0	13.0	63.0	48.0	23.0	48.0	....	51.0	77.2	79.0	13.3	....	.....	.....	.....	.....	4	....	1	of air through
	" 17...	......	6	17.0	16.0	59.0	51.0	11.0	50.0	....	55.0	85.6	80.5	18.8	....	24.0	.....	.....	.....	4	....	1	curtains.
	Averages	......	....	26.0	21.6	59.6	52.2	25.5	53.6	....	57.0	77.9	79.2	18.3	....	.....							
														*20.5	....	*20.9							
King System 2nd Test.	Mar. 3...	N.W.	9	21.0	17.0	58.0	55.0	18.0	55.0	58.0	60.0	74.3	70.8	17.8	....	20.2	open	1op'n	2 completely and 1 partially open.				
	" 5...	S.E.	18	38.0	36.0	59.0	55.0	26.0	57.0	59.0	62.0	75.2	77.2	14.5	16.7	17.8	"	"	"				
	" 6...	W.	40	38.0	33.0	59.0	54.0	38.0	59.0	60.0	62.0	70.3	77.2	11.1	14.4	15.6	"	"	"				
	" 7...	S.W.	11	30.0	28.0	59.0	53.0	31.0	60.0	....	‡(64)	.....	.....	18.8	....	‡(22.1)	"						
	Averages	......	19.5	32.3	28.5	58.8	54.3	28.3	57.8	59.0	62.0	73.3	75.1	15.5	....	18.9							
Muslin Curtain 2nd Test.	Mar. 9...	......	1	33.0	22.0	60.0	54.0	18.0	54.0	56.0	58.0	67.4	69.8	24.4	20.0	18.8	.....	.....	.....	4	1	1	
	" 10...	S.W.	6	36.0	28.0	57.0	50.0	25.0	55.0	57.0	58.0	74.3	75.6	13.3	....	10.0	.....	.....	.....	4	1	2	
	" 11...	S.W.	8	37.0	32.0	63.0	54.0	32.0	57.0	61.0	63.0	75.2	72.3	14.4	14.4	11.1	.....	.....	.....	4	1	1	
	" 12...	N.E.	12	40.0	34.0	61.5	53.0	34.0	57.0	59.0	61.0	69.2	65.9	12.2	11.1	8.9	.....	.....	.....	4	1	2	
	" 14...	S.W.	9–17	35.0	26.0	63.0	58.0	39.0	58.0	62.0	64.0	76.1	72.7	24.4	....	12.2	.....	.....	.....	4	1	2	
	Averages	......	8.0	36.2	28.4	60.9	53.8	29.6	56.2	59.0	60.8	72.4	71.3	17.7	....	12.2							
Averages:																							
King....	....	......	....	23.3	10.7	56.5	51.6	13.4	52.4	....	55.7	*74.8	*76.3	*12.7	....	*15.9							
Mus. Cur.	....	......	....	30.6	24.7	60.2	52.9	27.4	54.8	....	58.7	75.4	75.6	*18.5	....	14.7							

† Maximum and minimum readings in stable taken half way between ceiling and floor.
‡ Figures in brackets are interpolations based on general averages.
* In case of related readings, *e.g.*, "maximum and minimum" or "floor and ceiling," the averages include only the observations when both readings of the pair were taken.
C, Calm; Li., Light; Str., Strong; Irr., Irregular.

The first Muslin Curtain test shews CO_2 variations with the wind. Only two ceiling readings were taken, one being less than the corresponding floor reading and the other greater. Averaging the floor and ceiling readings for these two nights we have 20.5 and 20.9, pretty nearly the same.

The second test of the King system also shews variations with the wind, ceiling readings being uniformly higher than floor readings, the averages differing by practically the same amount as in the first test.

The Muslin Curtain in the second test shews a different distribution of the carbon dioxide, the floor amounts being largely in excess in all readings. There are certain variations for which no reason is apparent. Averaging floor and ceiling readings for all nights on which both were taken we find the floor averages to be 12.7 for the King system and 18.5 for the Muslin Curtain system, the latter being an increase of 43.4 per cent. over the former. We also see that on the average the distribtuion of the CO_2 for the two systems is directly opposite.

At this stage the mind involuntarily makes a comparison: 9 parts of carbon dioxide at the floor by the Massey system and 12.7 by the King system, the latter being 41.1 per cent. greater than the former. Yet in spite of this a person going into the two stables on the same night and judging by his sensations would say that the dairy stable was the better ventilated—and may be it was, for carbon dioxide is not the only impurity in stables.

Consulting the "humidity" columns of Table II we find for the King system an average humidity of 74.8 at the floor and 76.3 at the ceiling. Another comparison: Humidity at the floor by Massey system 86.1, by the King 74.8, and we have an explanation of the difference in sensations on entering the different stables. The air in the farm stable was much more humid than that in the dairy stable, a difference possibly explained by the fact that the former is a stone stable but the latter a frame.

The range of temperatures during the night in the dairy stable was nearly twice as great for the Muslin Curtain system as for the King, and in both systems the stable was much warmer than the farm stable. Had the King system been so regulated as to keep the stable about five degrees cooler the carbon dioxide content would have been lowered. What effect it would have had on the humidity is problematic.

In summing up we cannot regard the Muslin Curtain system as measuring up the requirements of even a fairly effective system of ventilation. It is irregular, uncertain and ineffective in action, the two tests in each stable shewing different distributions of carbon dioxide and moisture, and more of both than by the other system for that stable. In the King and the Massey each was consistent with itself, shewing always the same relative distribution of CO_2 and moisture. Hence we must judge the Muslin Curtain system as unreliable and inferior to both the systems against which it has been tested. The comparison is a fair one for in each case the same stable was ventilated by the systems compared. On the other hand, a comparison of the Massey and King systems from these data would not be fair, for they were tested in different stables with different conditions of elevation, exposure and stable structure, with different amounts of stable room per head of stock, the one for a mixed herd of growing and fattening cattle, the other for a herd of milch cows for which a warmer stable is usually desired, and lastly under the management of different herdsmen.

Respectfully submitted,

WM. H. DAY.

PART VI.

THE PROFESSOR OF CHEMISTRY.

To the President of the Ontario Agricultural College:

SIR,—In submitting my report for the year 1908, I wish to thank you for allowing me six months' leave of absence to visit some of the European chemical laboratories. I spent a very interesting and profitable summer, and had the privilege of meeting many chemists of renown in their own laboratories and observing their methods of investigating the intricate problems which are continually being brought to the attention of the agricultural chemist. I also had an opportunity of observing some of the methods of cultivation employed in the intensive farming of these older countries.

Among the most interesting places visited on the continent were Berlin and the district lying about Leipzig and Halle. In these places I met Dr. Zuntz and Dr. Kellner, two men whose work on animal nutrition has materially aided in placing cattle feeding on a good sound scientific basis. I visited the laboratories and experimental grounds at Bernburg and Lauchstadt, where the late Dr. Hellriegel and Dr. Maercher did their pioneer work on soil investigations, and where their worthy successors, Dr. Weismer and Dr. Schneiderwind, are continuing the work. I also visited the Saxony Fruit Experiment Station at Deimetz, and at Halle had a chance to see Dr. Wohlmann's experimental grounds and his large collection of wild and domestic animals which are being used in an attempt to develop superior types of domestic animals. In this district I also had an opportunity of going over several farms, one of which contained 2,000 acres and one fruit farm of 600 acres, and was thus able to see something of the methods of cultivation practised.

In England, I spent some time with Prof. Wood at Cambridge University and with Dr. Russell at Rothamsted, and visited several of the Agricultural Colleges of both England and Scotland, where I was always treated in the most cordial manner.

It was my pleasure to visit the National Exhibition at Prague, Austria; the Franco-British Exhibition at London; The Royal Agricultural Show at Newcastle-on-Tyne; the Highland Agricultural Show at Aberdeen, and the National Exhibition at Edinburgh, which afforded an excellent opportunity of seeing something of the agricultural possibilities of the several countries. I was also able to go over several large English and Scotch farms, where I was impressed with the thoroughness of the cultivation, and with the evident attention devoted to beautifying the home surroundings.

I am indeed deeply grateful to you for the privilege of visiting these places, and feel sure that the information gained, the acquaintances formed, and the enthusiasm aroused will greatly aid me in my College work.

The personnel of the staff of my department has remained unchanged during the year. The services of each member has been marked by a progressive efficiency that is encouraging. Prof. Gamble had charge of the work of the Department in my absence, and I wish to bear testimony to the able manner in which he discharged his duties.

One change in the arrangement of our work was made during the year. Mr. Gamble, who formerly taught the Inorganic Chemistry, Animal Chemistry, and Geology, has charge now of the Soil Chemistry in place of

the Animal Chemistry, and has been given the title of Professor of Soil Chemistry and Lecturer in Geology. He will also have charge of the investigation work with soils.

The work of instructing the students who attend the College from year to year forms the most important part of our work and consumes the major part of our time. It is, however, not necessary to outline the work here, as it may be found in the College Calendar and in former reports. The only change in the instruction work is that, owing to the growing importance of a thorough knowledge of remedies used in combatting the insect pests and fungus diseases, we have thought it advisable to give the specialists in Horticulture and Biology a fuller course of lectures with laboratory work on Insecticides and Fungicides. We also intend giving a course of lectures with laboratory work to the specialists in Horticulture on Chemistry in Relation to Vegetable and Fruits and the Canning Industry.

As usual a large part of my time is devoted to directing the work in the laboratories, answering letters of inquiry regarding many phases of farm work, writing articles for the agricultural papers and addressing farmers' meetings, and the conventions of Dairymen, Fruit Growers, Vegetable Growers, Millers, Bakers, etc. The time devoted to this work is continually increasing, and year after year consumes a larger proportion of my time.

A large number of samples of a great variety of substances have been examined during the year. The work done on some of these samples was small, while in other cases it was considerable. We are anxious to make the work of the department as useful as possible, and therefore, invite farmers and others interested in soils, manures, foods, dairy products, insecticides and fungicides, etc., to correspond with us. We cannot always make the analysis requested, partly because of the amount of work involved and partly because the sample sent has not been selected in such a way as to accurately represent the material of which it is a part; but we shall in all cases be pleased to give the fullest information we can.

INVESTIGATION WORK.

Swamp Soils.

In the spring of 1904, we commenced a study of the composition and peculiarities of Ontario Swamp Soils. Since then we have analysed nearly fifty samples of these soils and have done considerable experimental work with fertilizers to determine what effect the addition of the mineral plant food constituents has on the nature and yield of the crop. From time to time we have postponed the publication of the results until they could be further confirmed, and there are still several points on which we would like to get information, but we think that we have considerable data of an interesting and instructive character which might well be published in bulletin form. Therefore, we shall hold the detailed results, and report only a few of the general conclusions at this time.

According to the report of the Ontario Agricultural Commission, appointed in 1881, "to inquire into the agricultural resources of the Province of Ontario, the progress and condition of agriculture therein, and matters connected therewith," there was at that time a very large number of acres of what was known as swamp land. Almost every township is reported to have some such land, the estimated acreage varying from a few hundred to forty thousand acres or more. In the aggregate, there must have been hundreds of thousands of acres of these swamps.

Since that time many acres of swamp areas have been cleared and drained and are now being cropped more or less successfully. Where the swamp material lies over clay, and particularly if it is not too deep to allow some of the clayey materials to become mixed with the top soil, good results are usually obtained. When the materials are not sufficiently decomposed to form a soil that will hold water during the dry weather of the summer, or, when the subsoil is a sand, the results are invariably poor. This last type of soil usually produces fairly satisfactory crops during the first few years, but after the results are unsatisfactory. In so far as we were able to judge, however, these soils are not so common as the swamps over clay subsoils.

We collected and analysed forty-four samples of swamp soils from various parts of the province. The minimum, maximum and average results obtained from the air dried samples are as follows:

	Lowest	Highest	Average
Potash (K_2O)	.117	1.12	.426
Phosphoric acid (P_2O_5)	.12	.56	.281
Nitrogen (N)	.76	2.60	1.36
Lime (CaO)	.49	7.24	3.28

Out of the forty-four samples analysed only three contained less than one per cent. of lime and none of them were what might be called sour or acid. Eight of the samples contained less than 0.3 per cent. of potash and only six had less than 0.2 per cent. of phosphoric acid. In nearly every case the lowest percentage amounts of these plant food constituents were found in the swamp soils lying over a sandy subsoil. While these quantities of potash and phosphoric acid are not particularly large, there are many arable soils in Ontario producing good crops year after year which do not contain as much, and it is quite evident that the non-productiveness of some of these soils cannot be charged altogether to the lack of plant food.

These soils are naturally rich in nitrogen, but a very large proportion of it is held in an insoluble organic combination which is not available to plants. The results of the determinations of humus show that decomposition has proceeded further in some soils than in others, and it is quite possible that in many instances it does not take place rapidly enough to furnish a full supply of food to the plant. Some experiments which we have conducted in inoculating these soils with the ground germs by scattering a small amount of garden soil over the land, seem to indicate that decomposition can be hastened in this way and very much better results obtained. It also appears as though the good results commonly secured when farmyard manure is applied to these soils may be due to the same cause. In both cases, however, there is apt to be an over-abundance of nitrogen brought into an available condition and too rank growth of plant is produced.

The results obtained from the application of fertilizers have not been uniformly successful. This was doubtless due to the fact that some of the soils contained an abundance of the plant food constituents in an available form, and in other cases to insufficient drainage. In many instances, however, the crop was increased by fifty and one hundred per cent. by the application of potash or phosphoric acid, or the two together. Experiments were conducted with oats, corn and potatoes with muriate and sulphate of potash, superphosphate and Thomas phosphate, and with lime. Owing to the superphosphate being acid, Thomas phosphate appears to be the safer form of phosphoric acid to use. Lime has never given us appreciable results.

In general, it may be said that the first essential in bringing swamp soils into cultivation is good drainage, for none of our domestic plants can

make proper growth until the water held between the particles of soil is removed. Where the organic matter of the soil has not decomposed sufficiently to form a good firm soil, it is probable that inoculating by means of garden soil, or by the application of a light dressing of farmyard manure, will greatly hasten decomposition and thus liberate plant food and get rid of some of the excess of organic matter. Where the growth is fairly even, but small and wiry, manuring of some kind is necessary, and farmyard manure alone or, better, farmyard manure in small quantities and potash, and phosphoric acid, have given good results. In many cases these soils are deficient in available potash and phosphoric acid, and the supplying of these alone is all that is necessary to put the soil into a condition that will make it productive.

Cattle Foods.

Mill By-Products. During recent years an ever-increasing number of mill by-products are being placed on the market. Many of these are rich enough in protein to be valuable as feeds to be fed along with the ordinary roughage of the farm, while others are so low in protein and high in crude fibre as to be almost worthless; and, further, the farmer is unfamiliar with the composition of them. We have, therefore, thought it our duty to study these feeds, and have analysed all samples sent to us by stock feeders. In Bulletin 138 we have given the composition of a large number of mill by products, and in the following table we give the results of the analyses of a number of others, many of them entirely new products:

Name.	Moisture.	Protein.	Fat.	Fibre.	Nitrogen free extract.	Ash.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Wheat Bran	11.95	15.69	4.14	9.24	53.13	5.85
Wheat Middlings	12.30	15.81	4.22	4.16	60.19	3.42
Wheat Shorts	11.65	15.07	4.60	7.19	56.88	4.61
Cotton Seed Meal	8.51	43.63	13.37	5.51	22.03	7.05
Cotton Seed Hulls	11.80	4.18	2.01	46.61	32.91	2.59
Rice Bran	9.85	12.10	10.54	12.27	55.01	10.23
Rice Hulls	8.67	3.15	1.15	36.19	35.51	15.33
Rice Polish	10.10	12.11	7.21	3.25	62.17	5.16
Rice	12.44	7.42	0.51	0.21	78.95	0.47
Wheat	10.72	11.95	2.21	1.83	71.36	1.93
Barley	10.87	12.44	1.92	2.81	69.31	2.65
at Feed	7.82	15.21	6.68	6.51	59.86	3.92
at Dust	7.30	12.85	4.58	17.90	50.07	7.30
at Hulls	7.73	3.36	1.10	30.17	50.82	6.82
luten Meal	6.61	36.25	11.21	1.65	42.51	1.77
erm Feed	5.25	13.64	8.10	16.00	56.11	.90
ice Feed	9.17	12.24	11.89	11.46	46.65	8.59
humacher	12.75	12.31	2.64	9.76	59.55	3.08
ctor	13.10	9.91	1.78	10.71	61.02	3.48
nner Feed	11.54	11.38	2.11	7.23	65.37	2.37
jected Oats	7.51	9.51	3.84	12.99	63.71	2.44
ozen Wheat	9.36	15.43	2.63	2.68	67.88	2.02
heat Bran	8.88	13.28	3.07	12.22	57.13	5.42
tional Chop	11.49	11.96	12.40	16.43	45.10	2.68
iry Chop	9.90	9.00	3.63	19.08	53.75	4.64
g Chop	11.40	8.69	3.64	12.09	60.93	3.25
in (adulterated) Sample A	9.55	10.62	4.55	13.94	56.24	5.10
Sample B	10.20	11.50	4.61	12.87	56.02	4.80
Beans	11.70	14.98	4.87	22.15	39.14	7.16
ten Feed	8.37	16.32	6.11	6.34	59.65	1.21
ed Seeds	9.60	13.81	2.60	11.90	54.63	7.46

Most of the feeds herein reported are by-products in the manufacture of flour, starch, glucose, and cereal foods, and, as such, are likely to show marked variation in composition, because of the different methods of manufacture employed. The feeding value, etc., of many of these has been treated of more or less fully in former bulletins and reports, therefore, it is not our purpose to dwell upon it at this time. There are, however, certain points relative to cotton seed meal, gluten meal, gluten feed, wheat bran, etc., which have not heretofore been touched upon. These we desire to draw attention to in a few short paragraphs.

Cotton Seed Meal. The importance of protein in concentrated feed stuffs is so well known as to require no particular comment. It will be observed that cotton seed meal contains a high percentage of this constituent. It might be considered, therefore, as one of the most desirable of all of the highly nitrogenous feeds, but experience has shown that such is not always the case. That it can be used as a useful component of a ration for milch cows is well known, that is, if the quantity fed be limited to two or three pounds per day. But the use of cotton seed meal in feeding pigs, sheep and horses has not given good results, and in a number of cases on record has been followed by the death of most of the animals in the course of a few months.

Cotton seed meal varies as much in composition as any of the by-products. The proteids may vary from 25 to 48 per cent. and the fat from 8 to 18. The bright yellow meals, which are comparatively free from ground hulls, are considered the best. But it would appear as though the color cannot be taken as a true indication of the value of these foods; for some of the cotton-seed is naturally lighter in color than others, and, because of the prejudice in favor of the yellow colored articles, some of the manufacturers are now coloring their products to suit the demands of the market.

Gluten Meal and Gluten Feeds. A great deal of confusion exists as to the meaning of the different terms applied to these by-products from the manufacture of glucose. They are all derived from corn. The dry matter of the corn kernel contains nearly 75 per cent. of starch and 12 per cent. of protein. The starch is largely extracted from the corn for use in the manufacture of glucose, leaving a by-product rich in protein. The different products met with on the market and sold under the name of gluten meal and gluten feed are by-products obtained in the process of separating starch from the grain. The corn is first soaked in water for some hours, then coarsely ground and rubbed between mill stones, which remove the hulls and set free the starch cells. The material is then put on sieves of fine bolting cloth, and the starch and gluten pass through, while the germs and hulls remain on the sieves. The starch and gluten which go through the sieves are then forced through troughs or tanks of water and separated.

The hulls and germs of the corn remaining on the sieves are dried and placed on the market directly, or else treated with naphtha to remove most of the oil of the germs and are sold as gluten feed. The final residue obtained from the setting tanks, which is largely the gluten and oil of the corn, is dried and sold as cream gluten, or else the oil is extracted from it and the residue united with the germs and sold as gluten meal. Sometimes the corn hulls and germs are sold separately under the trade terms corn bran and germ meal; and not infrequently, as Mr. Shutt, Chemist of the Dominion Experimental Farm, has pointed out, the gluten feeds are retailed under the name of gluten meal. This is, of course, an impostion on the buyer, as the two materials are quite unlike, "gluten meal" being much the higher in protein content, as a glance at our table shows.

Some feeders are prejudiced against the use of gluten feeding stuffs, because of the belief that the sulphuric acid used in the manufacture of glucose affects the feeds. This prejudice is entirely unwarranted, as all of these by-products come directly from the corn by mechanical means of separation before the manufacture of glucose is begun.

The various gluten feeding stuffs have, in recent years, come into use very largely for feeding milch cows. They have been used with good results for increasing the quantity of milk, and the only objectionable effect noticed on butter has been a slightly softer texture. This may be overcome by using the gluten in connection with cotton seed meal. As previously mentioned, the chief difference in the composition of the glutens is the amount of protein, and their relative values can be estimated very closely by the percentages of this constituent contained in them. Gluten feeds, owing to the presence of corn hulls, contain considerably more fibre and starchy material and less protein than does gluten meal. The percentage of protein in gluten feed will vary from 12 to 24, and of fat from 8 to 11, while gluten meals contain from 22 to 35 per cent. of protein and 3 to 12 per cent. of fat.

WHEAT BRAN. This by-product consists of the outer covering of the wheat kernel when not ground, and is a bulky feed of great value for mixing with heavier grain feeds. The proportions of the various nutrients are so well balanced that it is one of the safest feeds and constitutes a portion of nearly every grain ration used by dairymen. Unfortunately, on account of the large demand for this feed, adulteration with oat hulls, etc., is now quite commonly practised. Wheat bran varies in protein from 14 to 17 per cent.

WHEAT MIDDLINGS. This feed is supposed to consist of the covering of the wheat seeds just beneath the hulls, including a small part of the darker colored flour, but the fine middlings often include a part of the flour.

When but little flour is present, the middlings contain more protein than does wheat bran. The presence of flour does not add materially to its value.

FEEDING VALUE OF FROSTED WHEAT. Last winter there was a very large quantity of the frosted wheat from the western provinces sold in Ontario for cattle food. This was partly because there was more than the usual amount of frozen wheat in the west, and partly due to the scarcity of grain at home.

All the samples sent to our laboratory were of at least fair quality, and would probably grade No. 1 or No. 2 frozen wheat, but a few samples were brought to our notice which were so light as to be little better in appearance than good chaff. It is not wonderful, therefore, that there should be some conflicting opinions regarding the value of this material as cattle food.

Altogether we analysed twenty-seven samples of the frozen wheat, the results of which are given in the following table, together with the average results of the analysis of inferior, rusted, and frosted wheat raised in Minnesota, and normal hard wheat.

It is generally thought that protein is deposited in the kernel at a comparatively early stage in the development of the seed, and that the filling out of the grain with starch continues practically until the straw is exhausted. Consequently, it is not surprising to find that the protein in the shrunken, frosted wheat is higher, the starch lower, and the woody fibre of the bran layers greater than in the normal wheat.

Composition of Frozen Wheat.

	Moisture.	Protein.	Fat.	Soluble Carbohy-drates.	Crude Fibre.	Ash.
1............	12.20	12.16	1.61	69.70	2.85	1.48
2............	11.65	12.92	1.58	69.80	2.41	1.64
3............	11.49	11.85	1.71	70.54	2.91	1.50
4............	10.42	15.25	1.25	67.20	3.13	1.75
5............	12.05	11.29	1.38	72.21	1.86	1.21
6............	9.37	13.56	2.20	70.97	2.47	1.43
7............	11.48	10.36	2.16	71.67	3.08	1.25
8............	9.09	13.36	1.73	71.94	2.89	.99
9............	13.34	12.78	1.49	69.03	1.92	1.44
10............	10.33	13.55	1.82	69.03	3.29	1.98
11............	9.66	11.91	1.61	72.71	2.89	1.22
12............	12.72	14.24	1.92	67.44	2.54	1.14
13............	11.28	14.72	2.27	66.21	2.46	1.46
14............	10.31	13.05	1.85	70.82	2.40	1.57
15............	14.67	12.48	1.16	67.30	3.05	1.34
16............	10.35	13.95	2.34	69.02	2.79	1.55
17............	12.21	12.24	1.87	69.38	3.21	1.09
18............	11.85	13.51	1.92	68.22	2.87	1.63
19............	11.63	12.38	1.65	69.28	3.54	1.52
20............	12.25	13.85	1.68	68.26	2.68	1.28
21............	11.54	13.30	1.73	68.88	3.18	1.37
22............	13.02	11.68	2.37	68.29	2.95	1.69
23............	12.88	12.42	1.64	68.62	2.90	2.54
24............	13.26	14.21	1.29	67.55	1.86	1.83
25............	11.31	12.14	1.82	70.08	2.93	1.72
26............	11.12	11.82	1.73	70.37	3.10	1.86
27............	11.80	12.87	1.73	69.21	2.88	1.51
Maximum......	14.67	15.25	2.37	72.71	3.54	2.54
Minimum......	9.09	10.36	1.16	67.20	1.86	.99
Average........	11.60	13.06	1.76	69.25	2.81	1.52

Wheat, inferior, rusted and frosted, raised in Minnesota.*

Maximum......	11.78	18.56	5.28	71.46	5.08	2.80
Minimum......	8.42	13.38	1.99	61.46	1.10	1.06
Average........	9.78	15.29	2.95	67.58	2.61	1.79

Normal wheat from Northern States. *

Maximum......	13.95	17.15	3.93	78.66	3.05	3.57
Minimum......	7.10	8.05	1.26	64.84	0.44	0.80
Average........	10.52	11.87	2.09	71.90	1.79	1.33

* A Compilation of Analyses of American Feeding Stuffs, Bulletin No. 11, Office of Experiment Stations.

The protein is the most valuable part of the food and the crude fibre the least; so that the higher protein of the frosted samples is more or less offset by the larger quantities of the undigestible fibre.

If we calculate the production values in terms of starch of these foods on the basis suggested by Warington in his book on the "Chemistry of the Farm," we find that 1,000 pounds of the frosted wheat we analysed, calculated from the average results, would give us a figure of 864, the Minnesota frosted wheat 897, and the normal wheat 886. Thus it will be seen that frosted wheat, such as we analysed, was but little inferior to the normal wheat in food value.

As mentioned before, all the frozen wheat sold in the province last winter would not come up to this standard, but when there is a fair weight and body to the wheat, it is safe to assume that it has considerable food value. So far as is known, the mere fact that it has been frozen detracts

LIME SULPHUR WASHES.

COMMERCIAL LIME SULPHUR SOLUTIONS. The lime sulphur wash is now generally recognized as one of the most efficient of the orchard sprays. When properly made and applied, it has been found to be the best material for combatting the San José Scale, and, in addition, it is very effective in destroying other kinds of small insects, and it is also an efficient fungicide. It is true that varying results have been obtained from the use of this wash, but this is unquestionably due to either lack of care in making or lack of thoroughness in the application. Good washes cannot be made in a haphazard way, nor can they be efficient in destroying the scale if the spraying is not done thoroughly; for to kill, the spray must come in contact with the insect or fungus that is to be destroyed.

There is no particular difficulty in preparing the wash, provided the directions are followed closely, but, too often, owing to inexperience or neglect, it is not boiled enough and varying proportions of the sulphur are left uncombined, thus decreasing the efficiency of the wash.

Recently several brands of these lime-sulphur washes have been prepared commercially and offered for sale throughout the fruit districts. The work of preparing the wash is unpleasant and dirty and no doubt many fruit growers would be glad to use the commercial article, provided they were sure that the strength of the wash, diluted as directed, was satisfactory, and that the cost was reasonable. There is no reason why the commercial lime sulphur wash, or lime sulphur solution, as it is usually called, should not be a satisfactory strength. Unfortunately some of the manufacturers have over-estimated the strength of the preparation and have given directions for a greater dilution than the product will warrant if it is to be comparable with the home-made boiled preparation.

During the past season we analysed four samples of one particular brand of lime sulphur solution, which, according to the directions, was to be diluted with eleven parts of water to make it of suitable strength for a winter spray. The following table shows the weight of combined sulphur in the commercial solution, diluted as directed, compared with the amount found n the wash prepared by boiling 20 pounds of lime, and 15 pounds of sulphur n water for one-half hour and one hour and diluting to forty gallons.

Iome-made wash boiled for one-half hour......	153.5	grams per gallon.
" " " one hour	161.0	"
o. 1 Commercial sample	113.3	"
o. 2 "	56.3	"
o. 3 "	62.6	"
o. 4 "	92.4	"

It is thus evident that none of these commercial preparations, diluted even times as directed, would contain nearly as much combined sulphur the home-made wash, even when only boiled one-half hour. To make them the same strength as the one hour boiled wash, they could only be diluted , 3.9, 4.3, and 6.3 times, respectively. It will thus be seen that, if diluted directed, the solutions will be very weak and inefficient, provided the me-made mixture is; as it stands, of proper strength, and, further, that if y sufficient water is added to bring them to the strength of the home-made sh, they will be much more expensive than the advertising matter would icate.

A Study of Some Points in Connection with the Lime.

Sulphur Washes. During the season Mr. Fulmer has studied somewhat fully some phases of the lime sulphur washes on which we had no definite data. At my request he has prepared the following brief statement of the results. A fuller discussion of the methods employed and the results obtained in the work will be given in bulletin form after we have studied the whole subject more fully.

This insecticide is considered by orchardists to be the most valuable substance yet found for combatting the San José Scale. Judging from the great variety of practices followed and opinions held in regard to the making of the wash, however, there seems to be a lack of definite information as to some of the underlying principles. Some of these differences relate to the kind and quantity of materials to be used, others to the method of cooking and the length of time necessary for complete cooking, and others to various minor details in the process of making and applying. There is no doubt that washes of differing quality and effectiveness can be made, depending upon the differences above mentioned, and it was with the aim of trying to settle some of these points, and other points concerning which we frequently receive inquiries, that we spent some time during the past summer in the study of the lime sulphur wash.

Some facts are already known which aid greatly in such work. For instance, it is known that if lime and sulphur be mixed in water and heat applied, combination with the resulting formation of various compounds takes place; and that this combination proceeds under the control of certain definite chemical laws. Further, the various compounds which are formed are given names;—sulphides, thio-sulphates, sulphites, and sulphates, the properties of which are known, also the conditions necessary for their formation and the analytical methods which can be used for estimating them. The comparative insecticidal value of the compounds is also known. Thus, the sulphides are the most valuable, thio-sulphates come next, and the other two are of little or no use. Consequently, since the lime sulphur wash is a mixture of these four things (with various amounts of impurities and uncombined lime and sulphur), its value can be gauged when its proportion composition is determined and two washes can be compared, one with the other as to superiority.

It might also be well to state that the less valuable constituents of the wash, viz., thio-sulphates, sulphites, and sulphates, are formed as the result of the decomposition of the valuable sulphides. This transformation proceeds more rapidly while the wash is hot or boiling. Consequently long boiling, although absolutely necessary in order to get the maximum amount of lime and sulphur into combination as sulphide, results in the formation of appreciable amounts of these other constituents, while undue prolonged boiling increases these amounts still more causing a depreciation in the value of the wash.

Different kinds of Lime for making Sulphur Wash.

Three kinds of lime were used in this experiment:—Beachville, Port Colborne, and Caledon. The analysis of these showed the following composition:—

Beachville	99.4	per cent. CaO
Port Colborne	86.4	" "
Caledon	91.6	" "

Washes were made from each of these limes, and analysed. Following is a table showing the results:

Formula:—Lime 20 pounds, sulphur 15 pounds.

——	Time Boiled.	Sulphur as Sulphides.	Sulphur as Thio-sulphates and Sulphites.	Sulphur as Sulphates.
	min.			
Beachville	60	12.19	1.76	.09
Port Colborne	60	12.77	1.83	.08
Caledon	60	12.89	1.76	.09

On looking over the above results, it is evident that all these limes produce washes of similar composition. We must assume, then, that these are of equal value and thus that no one lime has a value much greater than another for preparing the wash. These limes are all rich in calcium oxide, richer than we may always find, but since it requires about eight and three-quarter pounds of it to combine with fifteen pounds of sulphur to form the sulphide, it is not likely that many Ontario limes to be found on the market will furnish too little for the purpose, when the above formula is used.

EXPERIMENT No. II. The effect of increasing the proportion of sulphur to lime:

Amounts Lime.	Sulphur	Time of Boiling.	Sulphur as Sulphides.	Sulphur as Thio-sulphites.
lbs.	lbs.	min.		
20	15	60	12.89	1.76
20	20	60	15.61 } 16.00	2.54
20	20	60	16.40 }	2.54
20	20	120	16.18	2.68

Beachville lime was used in this experiment.

It appears from the table that it takes longer for the maximum amount of sulphur to go into combination where the higher proportion is used, as can be seen by referring to the table in Experiment No. III. Further than this, at the end of one hour only 92.7 per cent. of the sulphur is in combination as compared with 97.6 per cent. in combination where the lower proportion is used. Even at the end of this, only 94.3 per cent. is in combination. Therefore it seems better to preserve an appreciable excess of lime, in order to reduce the waste of sulphur, and the length of time necessary for boiling. Also an excess of lime is desirable in that the thoroughness of the spraying can be more easily controlled by means of the white washing effect on the trees, and in that it imparts a greater adhering quality to the wash.

EXPERIMENT NO. III. Length of time necessary for complete combination.

Formula. Lime 20 pounds, sulphur 15 pounds.

Lime.	Time Boiled.	Sulphur as Sulphide.	Sulphur as Thio-sulphate and Sulphite.	Sulphur as Sulphate.
	min.			
Beachville	20	10.94	1.48	.07
"	40	12.37	1.62	.09
"	60	12.19	1.76	.09
Port Colborne	20	11.04	1.27	.09
"	40	12.77	1.54	.12
"	60	12.77	1.83	.08
Caledon	20	11.29	1.48	.09
"	40	11.97	1.69	.09
"	60	12.89	1.76	.09

With the exception of the Caledon lime, the maximum combination was practically effected at the end of 40 minutes; with it one hour was required, at which time 98.2 per cent. of the sulphur was combined, a maximum figure.

The length of time which gives the greatest amount of combined sulphur is sufficient. Any increase in that time augments the cost of manufacture and decreases the effectiveness of the wash by breaking down the valuable sulphur compounds into less valuable ones, viz., sulphides into thio-sulphates, sulphites, and sulphates. In fact, prolonged boiling will actually reduce the total amount of sulphur in combination, as is shown with the Beachville lime in the above table. This last would happen most readily where direct heat is used for cooking, as in the pot or pan method. (See table in Experiment IV.)

EXPERIMENT NO. IV. To compare *steam* and *direct heat* methods of boiling.

Lime used. Beachville.

Formula. Lime 20 pounds, sulphur 15 pounds.

Method of Boiling.	Time Boiled.	Sulphur as Sulphide.	Sulphur as Thio-sulphate and Sulphite.
	min.		
Direct heat..............................	20	10.94	1.48
"	40	12.37	1.62
"	60	12.19	1.76
Steam....................................	20	10.94	1.13
"	40	11.86	1.69
"	60	12.52	1.69

From the above results it is seen that direct heat induces a more rapid combination of the lime and sulphur than does the steam heat, but gives a wash of slightly lower value. The difference shown, however, does not give any decided choice of method; but, considering the greater coonvenience of boiling by steam, it is perhaps the most desirable way to prepare the wash.

EXPERIMENTS No. V. To compare *Flour of Sulphur* and *Flowers of Sulphur* for making lime sulphur washes.

Lime used. Beachville.

Formula. Same as in Experiment IV.

Kind of Sulphur.	Time Boiled.	Sulphur as Sulphides.	Sulphur as Thio-sulphate and Sulphite.
	min.		
Flowers of Sulphur..................	20	9.67	1.06
"	40	11.33	1.83
"	60	11.62	1.83
Flour of Sulphur....................	20	10.94	1.48
"	40	12.37	1.62
"	60	12.19	1.76

These results show that Flour of Sulphur combines somewhat more rapidly and slightly more completely with the lime than does Flowers of Sulphur; and that there is less tendency shown to form the less valuable thio-sulphate and sulphite.

EXPERIMENT No. VI. Depreciation of wash if allowed to cool:

Lime used. Beachville.

Formula. Same as Experiment IV.

Treatment.	Sulphur as Sulphide.	Sulphur as Thio-sulphate and Sulphite.	Sulphur in Combination.
Cooked 60 minutes and analysed at once..	12.19	1.76	13.95
Cooked 60 minutes, cooled 24 hours, brought to boil and analysed at once..	11.91	2.01	13.92

These results show that the wash becomes less valuable when allowed to cool before being applied. The change is due to a breaking down of the sulphides into the thio-sulphates and sulphites.

EXPERIMENT No. VII. On the development of a green color in the wash during boiling.

It is thought by some who make and use the lime sulphur wash that the development of a green color is a good indication as to when boiling is complete. We found this color formation to be due largely to the presence of iron in the lime or to that derived from the vessel in which the boiling was carried on. The fact remains, at least, that in the absence of iron or some other similar metal, such as copper, lead, nickle, etc., this color does not develop, even after prolonged periods of boiling. Hence the color change cannot be used as an indicator. The length of time it takes for the color to develop depends upon the amount of iron, etc., which is present. With some limes with which we have worked the color appeared about the time that the maximum amount of sulphur is in combination, viz., one hour, and, therefore, in such cases serves as an indicator; but with other limes it did not develop until long after that period; while with others it developed within 20 minutes, at which time only about three-quarters of the sulphur is in combination. Plainly, then, the color change is an indication of completeness of boiling, only in the case of those limes which contain a certain quantity of iron or other like metal.

Incubation of Eggs.

The work on incubation which we began in 1907 was continued during the summer of 1908; but, in addition to a repetition of the study of methods of incubation, we extended the work to include a determination of the amount of carbon dioxide evolved by an egg during the period of incubation. Some interesting data have been obtained. This work has been done by Mr. Fulmer, who has prepared the following statement of the results. It is our intention to continue and widen the investigation as the subject opens up.

Method of Incubation. Our studies on the methods of incubation included, during the past season, the following treatments:— (a) water, (b) dry, (c) zenoleum disinfection, (d) hen's grease, (e) alcohol and hen's grease, (f) zenoleum and hen's grease. The same make of incubator was used in all cases, so as to eliminate any defect which different constructions might give; and natural incubation was included in order to afford us a basis for comparison.

Thus far our data on methods of incubation do not warrant us in drawing any definite conclusions, but the results of last season's work serve to further estabish our finding of 1907, viz., that there appears to be a marked relationship between the strength or vitality of a chick and the amount of lime which it has in its system at the time of hatching. The following data, which is taken at random from the numerous figures obtained in 1908, will serve to show this, and with one or two exceptions is characteristic of all the data obtained:

Table No. 1. Results from incubators showing Lime (CaO) content of chick and notes taken at time of removing from shell at the beginning of the twenty-first day:

Lime (CaO) *Grams.*	*Notes.*	*Lime* (CaO) *Grams.*	*Notes.*
.21828	Vigorous.	.16188	Rather weak, more so than preceding one.
.24648	"	.20508	Vigorous.
.24348	"	.20388	"
.22908	"	.19848	"
.24348	"	.15390	Very weak.
.22428	"	.18240	Weak in appearance.
.17928	Not vigorous looking, but not abnormally weak.	.10090	Exceedingly weak.

Whether lime is a cause or an effect is perhaps impossible to decide definitely. The chick may be strong because it has absorbed much lime; or, on the other hand, there may have been a vital force in the egg germ which was tending to produce a strong chick in any case, which, on account of its vital energy was able to take up all the lime which it required for its normal development.

Carbon Dioxide Evolved by an Egg During the Period of Incubation, and the Relationship Between the Amount of the Evolved Gas and the Amount of Lime Absorbed by the Chick. It is a well known chemical fact that carbon dioxide, in the presence of moisture, is able to render soluble and take into solution insoluble calcium carbonate. Since egg-shell is composed largely of calcium carbonate and since the developing chick requires a supply of calcium, or lime, for building its bone and other body structures, it is reasonable to expect that the shell is the source of

supply and that the developing and respiring embryo attacks and renders soluble (digests) the lime of the shell by means of the carbon dioxide which it excretes. If this be so, then there would likely exist some fairly constant ratio between lime absorbed and carbon dioxide evolved. For the purpose of demonstrating this, and, as well, to satisfy our curiosity as to whether or not CO_2 was evolved, and, if so, to what extent, during incubation, we have started and are still continuing experiments along this line.

We were not long in finding that carbon dioxide is evolved during incubation and in quite large quantity. The following table will show the results with one egg arranged in such a way as to show the run of carbon dioxide from time to time during the twenty-one days.

TABLE No. II. Showing run of carbon dioxide from incubating egg, from day to day:

Number of days.	Amount carbon dioxide evolved (grams.)	Average amount carbon dioxide evolved per day (grams.)
1st to 5th day inclusive	.2288	.04576
6th to 11th "	.4664	.07773
12th to 13th "	.5104	.2552
14th to 15th "	.7568	.3784
16th to 18th "	1.6632	.5544
19th day	.8008	.8008
20th "	.6424	.6424
21st "	.7832	.7832
Total	5.8520	

In all, this egg evolved a total of 5.8520 grams of carbon dioxide gas, enough to render soluble, if all were utilized, about 13.3 grams of calcium carbonate, or about 75 times as much as is usually taken up by the chick. The run of carbon dioxide from day to day gradually increased, as would naturally be expected, until the maximum is reached on the nineteenth day.

Now, is there any relation between the amount of this evolved gas and the amount of lime absorbed? When we began the incubation work in 1907, we started by having on hand the knowledge of the fact that the eggs under a setting hen are surrounded by large quantities of carbon dioxide gas and that the hen usually hatched chicks of greater vitality and higher lime content than we would obtain by artificial incubation. Of course a great deal of the carbon dioxide under a hen comes from her own body, and consequently, it was thought that by increasing the amount of carbon dioxide in the egg chamber of the incubators, which was naturally only about one-third or one-fourth as much in amount as under the hen, artificial hatches simulating natural ones might be obtained. On this assumption, and with this hope, carbon dioxode was introduced into the egg chamber of incubators by various means (See Bulletin 163, p. 55). The results were disappointing, for from the data which was obtained we could only conclude that there was no relation between the carbon dioxide surrounding the eggs during incubation and the amount of lime absorbed, although greater vitality appeared to be imparted, in some cases. The only point left, then, was to

get the amount of carbon dioxide evolved by the egg itself and to determine the lime in the chick hatched and find if any relationship existed there. So far, we have obtained the following figures:

TABLE No. III.

Egg.	Carbon dioxide (grams).	Lime (CaO) (grams).	Lime per gram carbon dioxide (grams.)	Remarks.
....	.5852	.01625	.02777	All died in shell before end of incubating period.
I...............	1.8216	.05925	.03252	
II..............	3.0668	.08775	.02861	
V	5.8520	.15889	.02097	Healthy chick hatched.
/	6.6809	.17439	.02609	" " "
/I..............	8.2984	.19200	.01878	" " "
/II	12.9800	.20378	.01293	" " "

It will be seen by examining the above table that a decided relationship between evolved carbon dioxide and absorbed lime exists. The ratio is not constant (column 4), but the greater the quantity of gas evolved, the higher is the amount of lime absorbed. It would seem from this, then, that it is the chick with the greater natural vitality, the one with the freer and more healthy respiration while incubating which will absorb the most lime, and will, consequently, come out of the shell with the stronger and better built body, more likely to withstand the hardships connected with the early life.

WHEAT AND FLOUR TESTING.

In last year's report I gave a description of the appliances we have for grinding wheat and testing the baking qualities of flour. At that time I stated we were prepared and willing to make baking tests and to mill and bake the flour of wheat sent to us by millers and bakers. During the year we have tested a large number of samples and apparently the results have been satisfactory. But it would appear as though many of the millers and bakers do not know of this flour testing plant, or are not familiar with the nature of the the work done, for most of the samples tested have been received from a comparatively few places.

Last December and again this month some fifty or sixty members of the Dominion Millers' Association met in the Chemical Laboratory to see our methods of testing flour, and also to see the results of the tests of the different standard grades of Western spring and fall wheats and such other work as we were able to bring before them. They appeared to be pleased with what they saw, and this year made several suggestions regarding lines of work which they wished investigated.

Testing Varieties of Winter Wheat. During the last year we have made three baking tests of the winter wheats grown on the Experimental Plots in 1907. It would have added a great deal of interest and value to the results obtained if we could have determined the yield of flour for the different varieties of wheat, but this is impossible on our mill. The best we can do is to make a straight grade flour from each wheat.

In February, 1908, we milled a portion of each sample of wheat, and, when the flour was about two weeks old, baked it. About six months later it was again baked. The results are given under 1st and 2nd bakings in the

following table. In November last, the remaining portions of the sample were milled, and the flour kept for about three weeks and then baked. This is the third baking reported in the table. We thus have the results of the freshly milled flour from wheat when about six months old and some of the same sample of flour when aged to the extent of six months, and the freshly milled flour from wheat approximately fifteen months old. The wheat and flour were kept in tin cans in a dry, well aërated room. The results of these tests are given in the following table.

The baking tests were made as described in last year's report, viz., 1[illegible] ounces of flour were mixed with water, yeast, and salt, and the dough formed allowed to "rise" in a proof oven, the temperature of which was accurately controlled, and when it was ready for the oven was baked at exactly the same temperature and for the same length of time. The weight and volume of the loaf were determined and then the loaf was cut through the centre and compared with the standard, in general appearance, colour and texture. The quality of the loaf was got from the average of these three points. The figures in all the columns but the first three and the last one represent the difference from the standard loaf expressed in percentages. The standard was made from a straight grade of commercial fall wheat flour of the same age as the flour to be tested. The first two tests were made in comparison with the same flour, and, consequently, as the standard had the same chance to "age" as the flour to be tested, the improvement with the age cannot be traced, except as it improved more or less in appearance, colour, and texture than the standard during the time it was kept. The only place we could show the influence to age of wheat and flour was in the size of loaf, and this we have endeavoured to do by calculating the percentage volume of the loaf in each of the three bakings on the basis of cubic content of the standard loaf of the first baking. The flour used as a standard in the third baking was nearly, but not quite, equal to that of the first and second bakings. It will thus be seen that the results given in the following table really represent three separate tests of the relative quality of the bread each wheat is capable of producing. The tests were made so as to bring out whether the flour from one wheat improved with age more than another, and, also, whether, when kept in the unground condition, aging influenced one variety more than another.

TABLE SHOWING BAKING TESTS WITH ONTARIO WINTER WHEATS.

Name of Variety	Bakings.	Absorption.	Gluten.	Yield of Bread.	Size of Loaf.	Appearance.	Color.	Texture.	Quality of Loaf.	Moisture
		%	%	%	%	%	%	%	%	%
Standard	1st	49.0	25.61	100.0	100.0	100.0	100.0	100.0	100.0	......
	2nd	47.0	......	100.0	100.0	100.0	100.0	100.0	100.0	......
	3rd	47.0	26.01	100.0	100.0	100.0	100.0	100.0	100.0	9.75
Abundance	1st	49.0	25.13	99.8	87.9	90.0	96.0	90.0	92.0	10.55
	2nd	47.0	......	98.8	88.1	90.0	96.0	90.0	92.0	......
	3rd	47.0	24.00	101.5	95.2	98.0	102.0	100.0	100.0	10.38
Amherst Isle	1st	50.0	23.82	106.5	97.6	101.0	96.0	100.0	99.0	9.56
	2nd	46.0	......	96.9	104.4	103.0	100.0	103.0	102.0	......
	3rd	48.0	22.74	101.2	100.0	100.0	100.0	99.5	99.8	9.45

TABLE SHOWING BAKING TESTS WITH ONTARIO WINTER WHEATS.—*Continued.*

Name of Variety.	Bakings.	Absorption.	Gluten.	Yield of Bread.	Size of Loaf.	Appearance.	Color.	Texture.	Quality of Loaf.	Moisture.
		%	%	%	%	%	%	%	%	%
American Banner	1st ...	50.0	24.41	101.1	90.4	90.0	98.0	90.0	90.3	9.39
	2nd ..	46.0	......	97.9	84.4	91.0	99.5	94.0	94.8	......
	3rd ..	49.0	23.66	100.6	104.8	102.0	99.0	100.0	100.3	8.90
American Wonder	1st ...	47.0	25.01	101.9	78.9	85.0	94.0	90.0	89.7	9.20
	2nd ..	46.0	......	99.6	79.4	92.0	98.0	98.0	96.0	......
	3rd ..	46.0	23.80	98.3	99.4	97.0	99.0	95.0	97.0	9.68
Arctic Junior	1st ...	47.0	26.33	99.8	95.8	100.0	101.0	100.0	100.3	12.50
	2nd ..	48.0	......	100.8	104.4	103.0	102.0	102.0	102.3	......
	3rd ..	49.0	23.80	99.6	107.4	102.0	103.0	103.5	102.9	8.78
Auburn	1st ...	46.0	26.81	100.0	81.7	91.0	95.0	92.0	93.7	10.56
	2nd ..	47.0	......	98.8	90.0	96.0	97.0	97.0	96.8	......
	3rd ..	50.0	26.00	102.1	110.2	99.5	100.0	95.0	98.2	8.09
Banatka	1st ...	55.0	30.16	102.4	100.0	103.0	98.0	102.0	101.3	9.50
	2nd ..	54.0	......	100.2	114.4	103.0	99.0	100.0	100.7	......
	3rd ..	51.0	28.47	100.6	106.6	104.0	99.0	100.0	101.0	9.57
Bald Pootung	1st ...	49.0	27.36	102.4	81.3	85.0	97.0	90.0	90.7	11.69
	2nd ..	48.0	......	98.5	85.6	96.0	98.0	99.0	97.7	......
	3rd ..	49.0	25.11	101.2	102.4	100.0	100.0	98.0	99.3	10.92
Bearded Pootung	1st ..	47.0	26.63	101.3	84.4	100.0	102.0	101.0	101.0	9.31
	2nd ..	48.0	......	99.6	104.4	100.0	99.0	101.0	100.0	......
	3rd ..	50.0	27.57	100.6	106.0	102.0	102.5	104.0	103.8	8.85
Beardless Rural New Yorker	1st ...	47.0	23.70	101.1	80.1	90.0	96.0	91.0	92.3	9.32
	2nd ..	46.0	......	95.0	80.6	93.0	98.0	94.0	95.0	......
	3rd	48.0	24.42	100.0	97.0	100.0	100.5	100.0	100.2	9.55
Buda Pesth	1st ...	50.0	21.61	105.5	94.4	104.0	98.0	103.0	102.3	10.06
	2nd ..	49.0	......	99.0	109.4	103.0	98.0	102.0	101.2	......
	3rd ..	53.0	28.33	100.6	116.2	107.0	101.5	106.0	104.6	9.35
Bulgarian	2nd ..	46.0	27.68	99.8	100.0	104.0	101.0	104.0	103.0	......
	3rd ..	48.0	27.75	102.1	99.4	100.0	101.0	101.5	100.8	9.16
Clawson Longberry	1st ...	51.0	27.17	105.7	88.6	95.0	97.0	97.0	96.7	9.76
	3rd ..	49.0	26.40	100.6	91.0	96.0	98.0	96.0	96.7	9.25
Crimean Red	1st ...	58.0	29.32	104.9	102.4	104.0	95.0	104.0	101.0	11.23
	2nd ..	50.0	......	101.0	101.9	103.0	98.0	104.0	101.6	......
	3rd ..	52.0	29.14	100.8	124.1	107.0	101.0	104.0	104.0	9.45
Dawson's Golden Chaff...	1st ...	51.0	25.01	104.7	81.9	90.0	95.0	97.0	94.0	8.56
	2nd ..	46.0	......	99.8	81.9	91.0	95.0	97.0	94.3	......
	3rd ..	49.0	25.14	101.2	100.6	98.0	99.0	98.0	98.3	9.55
Economy	1st ...	46.0	25.13	99.6	92.1	92.1	100.0	99.0	97.0	9.87
	2nd ..	47.0	......	99.4	100.6	97.0	96.0	95.0	96.0	......
	3rd ..	48.0	25.66	99.4	106.6	102.0	99.0	97.0	99.3	10.22
Early Genesee Giant	1st ...	49.0	26.33	99.4	95.2	95.0	97.0	94.0	95.7	10.59
	2nd ..	48.0	......	99.4	99.4	98.0	99.0	99.0	98.7	......
	3rd ..	48.0	24.75	99.8	100.0	101.5	101.5	100.0	101.0	10.42
Early Ontario	1st ...	52.0	26.00	103.2	98.9	100.0	96.0	100.0	98.7	9.05
	3rd ..	50.0	25.43	101.2	100.2	103.0	98.0	99.0	100.0	8.18

TABLE SHOWING BAKING TESTS WITH ONTARIO WINTER WHEATS.—*Continued.*

Name of Variety.	Bakings.	Absorption.	Gluten.	Yield of Bread.	Size of Loaf.	Appearance.	Color.	Texture.	Quality of Loaf.	Moisture.
		%	%	%	%	%	%	%	%	%
Early Red Clawson	1st	50.0	24.29	102.7	78.3	90.0	96.0	96.0	94.0	10.40
	2nd	46.0	......	98.5	80.6	90.0	98.0	99.0	95.7	......
	3rd	49.0	24.97	101.6	97.0	98.0	100.0	97.0	98.3	10.02
Early Red Chief	1st	50.0	27.05	100.6	86.7	89.0	97.0	90.0	92.0	......
	2nd	46.0	......	99.8	96.4	100.0	97.0	99.0	98.7	......
	3rd	49.0	26.88	100.6	98.8	100.0	100.0	100.0	100.0	8.35
Egyptian Amber	1st	51.0	25.85	103.0	100.0	101.0	96.0	101.0	99.3	10.61
	2nd	48.0	......	99.2	104.4	98.0	99.0	100.0	99.0	......
	3rd	49.0	24.06	100.1	111.4	104.0	101.0	102.0	102.3	9.03
Extra Early Windsor	1st	46.0	24.05	100.4	77.7	90.0	96.0	91.0	92.3	9.36
	2nd	46.0	......	97.5	88.1	80.0	100.0	85.0	88.3	......
	3rd	48.0	......	98.5	95.6	98.5	100.0	96.0	98.2	9.19
Forty-Fold	1st	46.0	26.33	101.1	79.5	96.0	101.0	97.0	97.0	......
	2nd	46.0	......	99.4	88.1	100.0	101.0	102.0	101.0	.....
	3rd	49.0	24.06	100.6	93.4	95.0	99.0	95.0	96.3	8.36
Geneva	1st	47.0	24.77	100.0	95.2	100.0	100.0	100.0	100.0	11.18
	2nd	46.0	......	99.2	88.8	100.0	100.0	100.0	100.0	......
	3rd	48.0	24.74	98.5	108.4	99.0	98.0	96.0	97.7	10.12
Genesee Reliable	1st	49.0	25.25	101.9	88.6	95.0	97.0	94.0	95.3	10.59
	2nd	46.0	......	98.5	99.4	102.0	99.0	101.0	100.7	......
	3rd	48.0	23.00	98.8	106.6	104.0	99.0	100.0	101.0	9.58
Ghirka	1st	48.0	27.53	99.2	93.4	94.0	97.0	95.0	95.3	10.24
	2nd	49.0	......	99.6	106.9	99.0	98.0	100.0	99.0	......
	3rd	50.0	26.74	101.5	112.0	102.0	100.5	105.0	102.5	9.32
Harvest King	1st	48.0	......	100.6	100.0	100.0	100.0	100.0	100.0	......
	3rd	49.0	23.00	100.0	109.0	102.0	98.5	95.0	98.5	9.58
Imperial Amber	1st	48.0	24.89	101.6	92.7	100.0	100.0	100.0	100.0	9.54
	2nd	47.0	......	98.5	100.0	104.0	99.0	103.0	102.0	......
	3rd	49.0	26.97	100.4	104.2	103.0	98.0	100.0	100.3	9.45
Iron Clad	1st	50.0	30.16	102.9	92.7	99.0	100.0	100.0	99.7	11.46
	2nd	48.0	......	99.4	91.9	99.5	100.0	100.0	99.8	......
	3rd	50.0	30.38	100.4	104.8	98.0	98.0	100.0	98.7	7.99
Kentucky Giant	1st	50.0	......	100.8	93.4	95.0	96.0	95.0	95.3	......
	2nd	46.0	......	100.2	104.4	102.0	95.0	98.0	98.3	......
	3rd	50.0	26.09	100.4	107.2	101.0	101.0	102.0	101.3	10.16
Manitoba Red Fife	1st	49.0	28.61	101.7	83.8	90.0	95.0	92.0	92.7	......
	2nd	46.0	......	98.5	88.8	99.5	97.0	99.0	98.5	......
	3rd	49.0	26.73	100.2	120.4	103.0	100.5	101.0	101.5	9.33
New Mammoth Amber	1st	48.0	26.71	99.6	84.9	96.0	99.0	98.0	97.3	11.10
	2nd	46.0	......	98.8	86.9	92.0	99.5	94.0	95.2	......
	3rd	48.0	24.39	100.0	101.2	101.0	101.0	100.0	100.7	9.57
Michigan Amber	1st	47.0	23.10	98.7	93.4	98.0	99.0	98.0	98.3	10.48
	2nd	46.0	......	97.9	98.8	100.0	98.0	100.0	99.3	......
	3rd	49.0	24.78	101.9	107.2	102.0	102.0	104.0	102.7	8.46

TABLE SHOWING BAKING TESTS WITH ONTARIO WINTER WHEATS.—*Continued.*

Name of Variety.	Bakings.	Absorption.	Gluten.	Yield of Bread.	Size of Loaf.	Appearance.	Color.	Texture.	Quality of Loaf.	Moisture.
		%	%	%	%	%	%	%	%	%
Mogul	1st ...	47.0	26.57	100.0	84.4	94.0	98.0	96.0	96.0	......
	2nd ..	46.0	......	98.3	93.1	97.0	98.0	98.0	97.7	......
	3rd ..	48.0	25.72	98.8	94.5	99.0	101.5	98.0	99.5	10.16
Monarch	1st ...	46.0	24.89	98.9	85.6	98.0	100.0	99.0	99.0	10.49
	2nd ..	46.0	......	100.8	101.3	97.0	100.0	97.0	98.0	......
	3rd ..	51.0	25.65	101.6	103.6	102.0	99.0	102.5	101.2	9.27
McGarvin	1st ...	50.0	25.85	105.7	98.6	101.0	94.0	102.0	99.0	8.16
	2nd ..	49.0	......	100.4	99.4	100.0	98.0	102.0	100.0	......
	3rd ..	47.0	25.29	98.3	95.9	100.0	100.5	99.0	99.8	10.82
McPherson	1st ...	47.0	27.29	100.0	88.6	90.0	97.0	94.0	93.7	9.81
	2nd ..	47.0	......	97.7	89.4	96.0	97.0	97.0	96.7	......
	3rd ..	50.0	25.74	102.1	112.0	104.0	102.0	101.0	102.3	8.62
Never Kill	1st ...	46.0	27.05	98.3	86.2	99.0	100.0	100.0	99.7	9.27
	3rd ..	48.0	25.92	98.5	94.5	99.5	98.0	96.0	97.8	9.95
New Invincible	1st ...	50.0	25.85	103.4	86.7	90.0	94.0	97.0	93.7	10.81
	2nd ..	47.0	......	100.0	88.1	96.0	97.0	98.0	97.0	......
	3rd ..	49.0	25.15	99.6	100.6	100.0	101.0	101.0	100.7	9.38
New Paris Prize	1st ...	47.0	25.31	100.4	79.8	89.0	97.0	90.0	92.3	9.47
	2nd ..	46.0	......	98.3	90.6	100.0	100.0	102.0	100.7	......
	3rd ..	48.0	23.34	99.6	98.8	98.0	100.0	98.0	98.7	9.62
Nigger Wheat	1st ...	47.0	29.56	100.4	91.6	98.0	98.0	96.0	97.3	11.08
	2nd ..	48.0	......	99.4	103.8	99.0	100.0	100.0	99.7	......
	3rd ..	49.0	27.66	100.0	99.3	100.0	102.0	105.0	102.3	10.42
No. 5 Red Wheat	1st ...	56.0	24.69	106.8	89.1	100.0	94.0	100.0	98.0	9.46
	3rd ..	49.0	24.55	101.9	88.0	98.0	99.5	97.0	98.2	10.49
No. 8 Red Wheat	1st ...	55.0	24.83	104.9	97.1	100.0	94.0	98.0	97.3	8.7[illegible]
	2nd ..	47.0	......	98.1	95.0	98.0	97.0	99.0	98.0	......
	3rd ..	50.0	23.07	101.7	99.4	97.0	99.5	96.0	96.8	9.75
Northwester	1st ...	49.0	24.89	101.5	89.1	98.0	100.0	98.0	98.7	10.7[illegible]
	2nd ..	48.0	......	99.4	100.0	100.0	101.0	101.0	100.7	......
	3rd ..	48.0	25.01	99.8	100.0	96.0	100.0	97.0	97.3	9.96
Onigara	1st ...	47.0	24.29	100.4	83.8	95.0	98.0	97.0	96.2	9.50
	2nd ..	48.0	......	100.4	91.3	96.0	96.0	96.0	96.0	......
	3rd ..	49.0	26.06	100.4	106.0	102.0	102.0	102.0	102.0	9.6[illegible]
Padin	1st ...	49.0	25.73	104.8	95.3	100.0	95.0	98.0	97.7	10.48
	2nd ..	45.0	......	100.6	100.6	102.0	98.0	100.0	100.0	......
	3rd ..	48.0	24.42	99.8	104.9	100.0	98.5	99.5	99.3	9.8[illegible]
Paramount	1st ...	50.0	25.51	101.3	90.0	96.0	98.0	95.0	96.3	10.2[illegible]
	3rd ..	48.0	25.08	99.6	105.4	103.0	103.0	104.0	103.3	10.3[illegible]
Prize Taker	1st ...	48.0	24.65	100.8	75.9	90.0	98.0	92.0	93.3	9.1[illegible]
	2nd ..	46.0	......	95.0	80.6	92.0	100.0	96.0	96.0	......
	3rd ..	48.0	21.71	98.8	93.3	96.5	98.0	96.0	96.8	8.8[illegible]
Prosperity	1st ...	46.0	21.78	100.2	80.1	90.0	94.0	91.0	91.3	10.6[illegible]
	2nd ..	48.0	......	99.6	96.3	94.0	98.0	95.0	95.7	......
	3rd ..	49.0	24.81	98.5	97.6	97.0	98.0	98.0	97.3	8.6[illegible]

TABLE SHOWING BAKING TESTS WITH ONTARIO WINTER WHEATS.—*Continued.*

Name of Variety.	Bakings.	Absorption.	Gluten.	Yield of Bread.	Size of Loaf.	Appearance.	Color.	Texture.	Quality of Loaf.	Moisture.
		%	%	%	%	%	%	%	%	%
Red Hussar	1st	47.0	24.89	99.2	75.3	90.0	94.0	91.0	91.7	10.66
	2nd	46.0	......	97.5	80.6	93.0	98.0	94.0	95.0	......
	3rd	48.0	22.62	97.7	91.5	97.0	101.0	94.0	97.3	8.13
Red Wave	1st	46.0	23.39	99.6	75.3	96.0	101.0	97.0	98.0	9.33
	3rd	49.0	21.48	101.7	91.0	95.0	101.0	96.0	97.3	8.69
Royalty	1st	47.0	26.05	99.6	85.6	96.0	99.0	98.0	97.7	9.83
	2nd	46.0	......	99.8	86.3	90.0	100.0	94.0	92.7	......
	3rd	47.0	23.88	99.6	104.9	98.0	100.0	98.0	98.7	10.46
Rudy	1st	49.0	25.49	100.6	96.4	100.0	99.0	99.0	99.3	10.34
	2nd	46.0	......	96.9	105.0	104.0	98.5	98.0	100.2	......
	3rd	48.0	24.33	98.5	115.6	103.0	100.0	102.0	102.0	10.32
ussian Amber	1st	47.0	24.77	100.6	90.4	100.0	102.0	102.0	101.3	10.77
	2nd	47.0	......	99.2	93.8	100.0	100.0	100.0	100.0	......
	3rd	48.0	23.19	100.6	98.8	101.0	101.5	100.0	100.8	10.51
cott	1st	55.0	27.28	104.9	97.8	100.0	94.0	98.0	98.8	8.80
	2nd	48.0	......	100.1	95.0	100.0	101.0	100.0	100.3	......
	3rd	49.0	26.97	102.1	109.7	102.0	101.0	104.0	102.3	9.36
ilver Dollar	1st	47.0	25.01	99.8	86.7	100.0	100.0	100.0	100.0	9.79
	2nd	46.0	......	98.8	95.0	98.0	99.0	100.0	98.0	......
	3rd	48.0	23.55	98.3	98.8	101.0	102.0	102.0	101.7	10.36
ilver Sheaf Longberry	1st	51.0	25.26	104.7	81.9	90.0	95.0	95.0	93.3	7.46
	2nd	48.0	......	100.4	88.1	94.0	97.0	100.0	97.0	......
	3rd	49.0	25.26	99.6	93.0	98.0	96.0	97.0	97.0	9.32
iperlative	1st	46.0	25.13	98.3	84.9	92.0	99.0	96.0	95.7	11.22
	2nd	46.0	......	100.4	90.6	94.0	96.0	95.0	95.0	......
	3rd	......	22.69	......	......	......	......	......	......	9.61
ismania Red	1st	49.0	29.56	104.2	79.5	95.0	97.0	96.0	96.0	10.38
	2nd	49.0	......	98.8	91.3	94.0	94.0	99.0	95.7	......
	3rd	52.0	28.44	102.9	112.0	103.0	100.0	96.0	99.7	8.18
readwell	1st	46.0	25.73	99.8	87.9	100.0	100.0	100.0	100.0	11.12
	2nd	48.0	......	98.8	96.3	100.0	100.0	102.0	100.7	......
	3rd	49.0	25.06	98.5	113.2	101.0	100.0	100.0	100.3	9.27
irkey Red	1st	49.0	22.06	104.8	98.1	103.0	96.0	103.0	100.7	10.48
	3rd	49.0	23.04	101.9	107.2	100.0	100.0	100.0	100.0	9.96
iscan Isle	1st	50.0	30.60	102.9	87.3	97.0	97.0	98.0	97.3	10.39
	2nd	51.0	......	100.4	93.8	101.0	98.0	102.0	100.3	......
	3rd	50.0	27.75	100.4	120.4	106.0	96.0	101.0	101.0	9.67
irsolaf	1st	49.0	27.29	101.1	98.7	100.0	94.0	95.0	96.3	11.55
	2nd	49.0	......	101.7	107.5	100.0	97.5	101.0	99.5	......
	3rd	50.0	28.49	100.4	109.7	105.0	94.0	102.0	100.3	9.21
nide	1st	46.0	26.71	99.8	87.9	96.0	97.0	94.0	95.7	10.61
	2nd	47.0	......	97.9	103.8	97.0	99.5	99.0	98.5	......
	3rd	48.0	25.50	100.4	105.4	98.0	100.0	94.0	97.3	9.78

It will be noticed that the per cent. of water absorbed by the flour was in nearly every case lower in the second baking than in the first. No determinations of moisture were made at the time of the second test, but it is probable that after the heat was turned off the building in the spring, the flour absorbed some moisture. As pointed out earlier, the flour used in the third test was made from wheat kept in the laboratory until October, or for about fifteen months. This flour was, in most cases, drier than that made the previous winter, and the absorption was better.

The results of the determination of yield of bread are naturally not so reliable as if a larger quantity of flour were used in the baking; but they are fairly accurate when taken for the purpose of comparison, and much better results can be secured on the other points with the small loaves. Very frequently the smaller loaves weigh the most. As all the loaves were made from the same weight of flour, the differences in weight of bread must be due to difference in the ability of the flour to take up water and hold it in the bread when it is baked. The smaller loaf will naturally present less surface for the evaporation of water, and, as the gluten is either less in quantity or poorer in quality, the bread is less porous, or more sodden. It will be noticed that the yield of bread is greater and the loaf smaller with the first than with the second baking. This would naturally lead one to suppose that the sooner the flour is baked, the better for the baker, but reference to the other columns of the table shows that the loaf improved in size, and that the quality was better when the flour was kept for some time. The full effects of the aging are not brought out in the table, for it will be remembered that the standard used in the first and second bakings was the same and that the standard aged with the samples. Consequently, the better quality of loaf got in the second baking indicates that many of our samples of flour improved more during the six months between the two bakings than the standard, and not that the bread of the second baking was just that much better than at the time of the previous baking. The full improvement in aging can only be seen in the size of loaf; for in this case the volume was figured in percentage of the cubic content of the loaf of the first baking.

The main object was not to study the influence of age on wheat and flour; but to get definite data regarding the yield and the quality of the bread each wheat was capable of producing. The comparative strength of the flours from the wheats is shown in columns giving the "yield of bread" and "size of loaf," and the quality of the flour is brought out in those giving the comparative "appearance," "color," and "texture." The "quality of loaf" is the average of the last named three columns. Taking the third baking as a basis of comparison, the largest loaf was got with Crimean Red, which had a volume of 124.1 as compared with the standard at 100 and an average quality of bread of 104. Buda Pesth had a volume of 116.2 and an average quality of bread of 104.6, while Red Wave had a volume of only 91.0 and an average quality of 97.3. Prize Taker, Never Kill, Silver Sheaf Longberry, Forty Fold, Red Hussar and several others are not much superior to Red Wave. Among the well known varieties, Early Genesee Giant, Egyptian Amber, Michigan Amber, Nigger wheat, Scott, Treadwell, and Turkey Red gave results above the standard, and Dawson's Golden Chaff, Early Red Clawson, Clawson's Longberry, and American Wonder, below the standard.

The ideal wheat is a heavy yielding variety having good milling and baking characteristics. Yield naturally commands the first attention, but we cannot get away from the fact that the wheat is grown to be converted into flour which must have the necessary strength to produce a good loaf of bread.

Therefore, quality of product must be combined with high yielding properties in order that our farmers may command the best price for their products. In order that a comparison may be made of the baking qualities, as given in the above table, with the yield of wheat per acre, we have obtained data on this latter point from the Experimental Department and have incorporated it as a separate table, as follows:

WEIGHT OF GRAIN PER MEASURED BUSHEL AND YIELD OF GRAIN PER ACRE.

Varieties.	Weight per Measured Bushel.	Yield of Grain per Acre.	Varieties.	Weight per Measured Bushel.	Yield of Grain per Acre.
	Lbs.	Bus.		Lbs.	Bus.
Standard			New Mammoth Amber	61.94	42.37
Abundance	61.56	63.85	Michigan Amber	62.00	48.20
Amberst Isle	61.69	47.47	Mogul	61.94	60.23
American Banner	61.94	63.75	Monarch	61.38	49.27
American Wonder	61.31	77.12	McGarvin	62.44	52.35
Arctic Junior	62.88	43.88	McPherson	61.63	44.13
Auburn	63.88	40.45	Never Kill	62.38	44.40
Banatka	63.31	49.97	New Invincible	61.50	46.48
Bald Pootung	61.50	42.30	New Par's Prize	59.19	35.50
Bearded Pootung	63.31	37.92	Nigger Wheat	62.31	41.87
Beardless Rural New			No. 5 Red Wheat	60.50	43.55
Yorker	61.88	63.75	No. 8 Red Wheat	61.56	49.63
Buda-Pesth	62.75	45.92	Northwester	64.00	48.43
Bulgarian	62.81	50.33	Onigara	62.88	37.58
Clawson Longberry	61.56	61.93	Padin	61.50	49.25
Crimean Red	63.31	46.48	Paramount	61.81	52.90
Dawson's Golden Chaff	61.94	60.63	Prize Taker	61.88	62.73
Economy	61.94	45.33	Prosperity	61.50	48.13
Early Gehesee Giant	62.06	51.88	Red Hussar	60.38	46.48
Early Ontario	61.88	46.92	Red Wave	59.56	36.73
Early Red Clawson	60.06	48.18	Royalty	61.63	51.33
Early Red Chief	60.56	46.43	Rudy	62.25	41.17
Egyptian Amber	62.50	52.30	Russian Amber	62.56	48.98
Extra Early Windsor	61.81	61.67	Scott	61.56	41.43
Forty-Fold	62.00	62.77	Silver Dollar	60.06	47.47
Geneva	63.13	45.92	Silver Sheaf Longberry	62.44	44.10
Genesee Reliable	62.88	50.75	Superlative	61.19	62.78
Ghirka	62.81	37.72	Tasmania Red	63.56	44.32
Harvest King	62.06	48.80	Treadwell	62.56	56.22
Imperial Amber	63.00	40.70	Turkey Red	62.38	49.85
Iron Clad	63.75	32.17	Tuscan Isle	61.25	35.70
Kentucky Giant	63.19	44.56	Yarsolaf	63.13	46.40
Manitoba Red Fife	61.63	42.62	Yeuide	63.13	36.77

There appears to be some relationship between yield per acre, weight per measured bushel and quality of flour as indicated by size and quality of the loaf of bread it will produce.

YIELD AND WEIGHT OF WHEAT, AND QUALITY OF FLOUR COMPARED.

No. of Samples.	Yield per acre, bus. average.	Weight per measured bushel, average.	*Size of loaf*, average.	Quality of loaf, average.
0 above 60 bushels	63.84	61.78	97.3	98.5
0 between 45 and 60 bushels	49.27	62.05	104.4	100.2
3 below 45 bushels	40.52	62.19	105.3	100.3

The above table shows that, taking the average of the results obtained for the individual wheats and flours, as the yield of wheat per acre decreased, the weight per measured bushel and the size and quality of the loaf the flour was capable of producing, increased.

This statement, however, cannot be applied to individual cases, for there are two or three of the very poorest bread making wheats in the last or lowest yielding group. These are: Red Wave, No. 5 Red Wheat, and Silver Sheaf Longberry. The Crimean Red and Buda Pesth which, as previously stated are the best bread-making wheats in the number tested, stand in the second group; and in the first group of wheat, which gave a yield of over 60 bushels per acre, we find Abundance, American Wonder and Egyptian Amber from which bread was made having qualities considerably above the average. Naturally the best variety of wheat, all points taken into consideration, is the one which will produce the largest number of bushels per acre of wheat and that will yield a large amount of flour capable of being converted into a first class quality of bread.

A study of the data presented indicates that there are some very poor varities on the list and that there are a number of others which will give good results to both the farmer and the miller.

Chemistry in Relation to the Dairy.

During this past season we have not been able to complete any particular line of investigation undertaken in connection with the Dairy Department, but work has been done on three distinct lines. These are:

1. A study of the rate of the change of the insoluble curd of green cheese into soluble compounds as influenced by the temperature of the room in which it is held. Some work was done on this in 1901 and 1902 and reported in Bulletin 131, but there appears to be need for deeper investigation, and a commencement has been made to further study the subject.

2. A study of the loss of milk solids incurred in manufacturing over-ripe milk into cheese. A large number of determinations have been made of the loss of total solids and protein in the whey when normal and over-ripe milk were used in the manufacture of cheese in small vats of the experimental Dairy Department. It is claimed, however, that the conditions were not comparable with those found in large vats in actual factory practice. Hence, we have thought it advisable to study the matter more fully in direct co-operation with the factory cheese-maker before publishing any results.

3. A study of the condition or composition of milk which makes it necessary for the cheese maker of one factory to "set" the milk with a higher degree of acidity than that employed in another and, frequently adjoining, factory. Through the kindness of Mr. Herns, Chief Dairy Inspector, in the western part of the Province, we have secured a few samples of this milk and a careful analysis, especially of the ash, will be made, but it is quite probable that some work in connection with the matter will have to be done in the factories affected next season.

In conclusion, I beg gratefully to acknowledge the hearty co-operation of the various College departments in the carrying out of our year's work.

Respectfully submitted,

R. HARCOURT.

PART VII.

THE PROFESSOR OF SOIL CHEMISTRY AND LECTURER IN GEOLOGY.

To the President of the Ontario Agricultural College:

SIR,—I beg to submit herewith my report for the year 1908.

First and foremost let me thank you and Professor Harcourt for having effected with the Minister of Agriculture a division of the Chemical department, which has given me the position of Professor of Soil Chemistry. This recognition of my services affords me much pleasure, and I trust will be satisfactory to all interested in the chemical work of this College.

Consequent upon this change, I have been enabled to make use of space in the basement of the building for the care and exhibition of specimens of minerals and rocks for the use of students in the study of geology, the teaching of which is part of my duties. I desire here to express my thanks to you for a grant for the purchase of some of our specimens of minerals, and to the Department of Mines at Ottawa for their gratuitous donation of an exceedingly handsome cabinet of Canadian rocks and minerals, numbered and catalogued by Mr. A. A. Johnston, Curator of the Museum for the Dominion Department of Mines, to whom I desire to express my deep sense of obligation for his unwearying courtesy and assistance and for the promise of further help in the future.

The Imperial Oil Company, Ltd., of Sarnia, I must also thank for their donation to our museum, of a large collection of specimens of oils, waxes, and paraffin, products of the oil fields of western Ontario. These specimens will enhance the value of the collection already in the museum.

As a result of the division of the department already mentioned, some changes have been made in my classes. Formerly I taught animal chemistry to the second and fourth years, now I teach the students of these years agricultural chemistry. In connection with this course I have prepared for afternoon work a set of experiments intended to supplement the teaching of the lectures given in the forenoon. As this is the first year I have put this method into practice, though hopeful of good results, I shall not known the value of the plan until the college year is over. I shall, therefore, leave this matter for fuller report next year.

INVESTIGATION.

The number of cattle feeds on the market is increasing year by year, owing largely to the increased demand for prepared breakfast foods. The method of manufacturing our cereals into human foods is also changing, so that their by-products have a different composition from what they had only a few years ago. For example, we find bran, linseed meal, and other by-products referred to as "old" and "new process" feeds. The manufacturers also make a practice of putting the sweepings of the mill and similar refuse into the feeds.

These facts, together with others, have led many of the Experiment Stations to publish bulletins giving the chemical and, in some cases, the physical analysis of the cattle feeds sold in the state or province.

In addition to this, a number of the States have passed what are known as "Feeding-Stuff Laws," which require all manufacturers and vendors to

give a guarantee of the percentage of protein and fat in any sample of feed offered for sale. This is certainly a move in the right direction, but it is a well known fact that such guarantee, while furnishing, in a general way, information which would lead to a more intelligent selection of feeds, gives no criterion of the absolute nutritive value of the feeds. It is as important that the feeder of live stock should know what amount of the different nutrients is capable of being assimilated, as it is to know the composition of the feeds in question, for it must be remembered that it is not so much what an animal eats as what it digests that is actually turned into account. Two feeds may have very much the same chemical composition and yet differ materially in nutritive value. Therefore, any information regarding the digestibility of the feeding-stuffs on the market should be of interest to all intelligent feeders. Such information is obtained from actual feeding experiments.

The digestibility of a feeding-stuff is estimated indirectly by determining the undigested matter eliminated from the body in the solid feces and substracting it from the total amount contained in the feed. Hence it is essential that a preliminary feeding be continued for a sufficient length of time to remove the residue of previous feeds from the digestive organs; and, further, that the experiment extend through a number of days in order to eliminate the influence of irregularity of excretion.

Strictly speaking, the results thus obtained do not represent actual or true digestibility for the reason that the feces contain, not only that portion of the feed that is not digested, but also other materials which contain what is commonly designated as metabolic products. These consist largely of residues of secretions poured into the alimentary canal and not resorbed, together with katabolic products produced by the breaking down of the cells of the digestive organs. To obtain the actual digestibility, it would be necessary to separate these from the actually undigested feed and deduct the ingredients of the latter from those of the feeds eaten. No satisfactory method for separating the undigested residue from the metabolic products of the feces has been devised, and it is customary to designate the difference between food consumed and solid excrement as digestible matter, and to assume that the error involved is not serious. Hence the results obtained are slightly below the actually digested amounts.

The principles of all digestion experiments are simple. The feed is carefully sampled and analysed. Weighed quantities are fed to the animals. The solid excrement, which represents the undigested portions of the feed, is collected, weighed, carefully sampled, and analysed.

Prof. Jordan, while at Maine, and Prof. Atwater, at Connecticut were the first to take up this line of work. Later in Pennsylvania, Minnesota, Wyoming, and in our own Province this line of investigation was continued.

An account of the work done in Ontario was given in the College Report for 1906; since the publication of which we have conducted experiments to determine the digestibility of the following feeds:

Oat Dust, obtained from Martin Bros., Mount Forest.

Barley Dust, obtained from Tillson & Co., Tillsonburg.

Corn Meal, obtained from I. E. Simpson, Merlin.

Molac, Schumacher, Banner and Victor feeds, obtained from the Quaker Oats Company, of Peterborough.

Of the latter four feeds we can say very little at present, as the experiments on these feeds are still under way. The digestibility, calorific value, and fuel value of the other three feeds will be, in the pages which are to follow, compared with that of Wheat Bran obtained from the Goldie Flour Mills, Guelph, the digestibility of which we have also determined.

Table of Stock Food Experiment.

Experiment.	Moisture	Protein.	Fat.	Fibre.	Nitrogen free extract.	Ash.	Total.
Oat Dust.							
Analysis ....p.c.	12.00	14.22	4.61	7.21	58.54	3.42	100.
Steer No. 1.							
Amounts fed ....lbs.	7.56	8.96	2.90	4.54	36.88	2.15	63.
Amounts uneaten..........lbs.	.78	.60	.16	.48	4.05	.11	5.18
Amounts eaten ....lbs.	6.78	8.36	2.74	4.06	32.83	2.04	57.82
Air-dried Excrement .... p.c.	7.35	13.12	3.01	13.21	58.99	4.32	100.
Air-dried Excrement .... lbs.	1.606	2.866	.658	2.886	12.886	.944	21.846
Amounts digested ....lbs.	....	5.494	2.082	1.174	19.944	....	....
Per cent. digested	....	65.71	75.98	28.91	60.75	....	....
Steer No. 2.							
Amounts fed..............lbs.	7.92	9.38	3.04	4.75	38.63	2.25	66.
Amounts uneaten..........lbs.	.46	.44	.16	.32	2.04	.07	3.49
Amounts eaten ....lbs.	7.45	8.94	2.88	4.43	36.59	2.18	62.51
Air-dried Excrement .... p.c.	7.04	12.82	3.33	12.96	59.43	4.42	100.
Air-dried Excrement .... lbs.	1.701	3.097	.805	3.131	14.359	1.068	24.161
Amounts digested..........lbs.	....	5.843	2.075	1.299	22.231	....	....
Per cent. digested............	....	65.35	72.05	29.32	60.75	....	....
Barley Dust.							
Analysis.....................	9.21	14.08	1.95	10.39	57.42	6.95	100.
Steer No. 1.							
Amounts eaten ....lbs.	5.204	7.955	1.102	5.870	32.442	3.926	56.5
Air-dried Excrement .... p.c.	12.01	10.72	1.60	14.56	51.49	9.62	100.
Air-dried Excrement .... lbs.	3.192	2.849	.425	3.869	13.684	2.555	26.574
Amounts digested..........lbs.	....	5.106	.677	2.001	18.758	....	....
Per cent. digested............	....	64.19	61.43	34.09	57.82	....	....
Steer No. 2.							
Amounts eaten ....lbs.	5.710	8.730	1.209	6.441	35.600	4.309	62.
Air-dried Excrement .... p.c.	7.90	12.49	1.59	14.19	50.13	13.70	100.
Air-dried Excrement .... lbs.	2.460	3.889	0.496	4.419	15.609	4.266	31.139
Amounts digested ....lbs.	....	4.841	.713	2.022	19.991	....	....
Per cent. digested............	....	55.45	58.97	31.39	56.15	....	....
Corn Meal.							
Analysis..................p.c.	9.21	11.63	4.83	3.25	69.53	1.55	100.
Steer No. 1.							
Amounts eaten.............lbs.	5.710	7.211	2.995	2.015	43.109	.961	62.
Air-dried Excrement .... p.c.	8.82	18.42	1.52	3.96	65.27	2.01	100.
Air-dried Excrement .... lbs.	.518	1.081	.089	.232	3.831	.118	5.869
Amounts digested ....lbs.	....	6.130	2.906	1.783	39.278	....	....
Per cent. digested............	....	85.01	97.03	88.49	91.11	....	....
Steer No. 2.							
Amounts eaten.............lbs.	4.283	5.408	2.246	1.511	32.331	.721	45.5
Air-dried Excrement .... p.c.	10.11	18.96	2.31	4.31	63.12	1.19	100.
Air-dried Excrement .... lbs.	.732	1.373	.167	.312	4.572	.086	7.242
Amounts digested..........lbs.	....	4.035	2.079	1.199	27.759	....	....
Per cent. digested............	....	74.61	92.57	79.35	85.86	....	....
Wheat Bran.							
Analysis ....p.c.	10.52	15.23	4.37	10.31	54.12	5.45	100.
Steer No. 1.							
Amounts eaten.............lbs.	6.312	9.138	2.622	6.186	32.472	3.270	60.
Air-dried Excrement .... p.c.	11.45	12.01	5.30	15.86	45.62	9.76	100.
Air-dried Excrement .... lbs.	2.145	2.251	.993	2.972	8.549	1.829	18.740
Amounts digested..........lbs.	....	6.887	1.629	3.214	23.923	....	....
Per cent. digested............	....	75.37	62.13	51.97	73.67	....	....
Steer No. 2.							
Amounts eaten ....lbs.	6.312	9.138	2.622	6.186	32.472	3.270	60.
Air-dried Excrement .... p.c.	11.55	13.65	4.57	14.22	45.98	10.03	100.
Air-dried Excrement .... lbs.	1.932	2.284	.765	2.379	7.692	1.678	16.730
Amounts digested..........lbs.	....	6.854	1.857	3.807	24.780	....	....
Per cent. digested............	....	75.00	70.82	61.54	76.25	....	....

In carrying out the experiments we used a crate made specially for the purpose. The platform was just large enough to permit the steers to stand up comfortably, and wide enough to enable them to lie down with ease. The floor of the crate was made of slats, placed far enough apart so that the liquid excrement could run through. The manger was arranged at the front for the feed, and a suitable box was placed at the back end of the crate to receive the droppings. The whole crate was raised about two feet above the ground, so that the animals could not step back into the box; and a special fixture was attached behind the steers to prevent their stepping back into the droppings. This fixture also prevented the steers from getting away should they become untied.

The animals used in a number of these experiments were two grade steers, fully developed. They were fed only one kind of feed during each trial, besides, of course, a supply of drinking water. After each experiment they were given a rest of about three weeks, and during that time they were fed ensilage, hay, and roots.

The following are the data observed:

Oat Dust Experiment. Preliminary feeding 9 days, Trial 5 days. Both steers ate this feed readily. Steers lost weight, but appeared to be in perfect health.

Barley Dust Experiment.—Preliminary feeding 10 days. Trial 6 days. Notes: Both steers lost weight during this experiment. Neither appeared to thrive on this feed. Steer No. I. did not eat for two days and Steer No. II. for one day during the preliminary period.

Corn Meal Experiment.—Preliminary feeding 8 days. Trials 5 days. The steers were in good health and quiet; corn meal fed alone.

Wheat Bran Experiment.—Preliminary feeding 6 days. Trials 5 days. The wheat bran was fed alone.

It has been frequently assumed that the same kinds and amounts of nutrients have the same value whatever their source. This would mean, for instance, that a pound of protein or carbohydrates from oat dust or barley dust would have the same nutritive value as a pound of protein from corn meal or wheat bran. A brief review of the preceding table is sufficient to show that such is not the case, as the digestion co-efficients of the constituents of the latter two feeds are much higher than those of the former. Again, we sometimes hear it stated that the larger the amount of woody fibre, the less completely is the feed digested, and the more muscular work is required for chewing the food and for moving it through the alimentary canal. This is doubtless true in some or perhaps in most cases, but, as the results of our experiments show, this statement cannot be taken as an absolute maxim. For, though the percentages of crude fibre in the samples of wheat bran and barley dust used were the same, yet there is a very wide difference between the amount of materials extracted by the animals from these feeds. In the case of wheat bran, the average digestibility of the dry matter is about 62 per cent., while the digestibility of that of the barley dust is only 45.5. Then, too, though we have not determined the energy of muscular work referred to in the above, yet it seems to us reasonable to assume that the greater the amount of a feed which remains undigested the greater will be the expenditure of energy required to eliminate it from the system; and if this is so, then it does not necessarily follow that the amount of woody fibre is the only factor which determines the expenditure of energy. It may be said, therefore, that the completeness of digestion and "ease of digestion" are factors which must be reckoned with, and the actual nutritive values of feed stuffs are quite different from those calculated simply from their composition. From the table of experiments we also learn that the individuality

of the animal has considerable influence on the digestibility of the fed. For instance, Steer No. 1 digested more of all of the constituents in the barley dust and corn meal than did Steer No. II. Hence it is very important in carrying on digestion experiments, in which different feeds are being compared, that a number of animals be used, in order that the effect of the individuality of the animals be eliminated.

The best basis on which we may compare various feeding-stuffs, is their energy producing power, commonly expressed as heat units. Extensive experiments have been conducted to find out the relative energy or heat values of protein, fat, crude fibre, and carbohydrates. These results show that one gram of protein, when oxidized to carbon dioxide and water and urea will liberate 4.1 Calories of heat, one gram of fat will liberate 9.3 Calories, and one gram of crude fibre or carbohydrates will liberate 4.1 Calories when oxidized. Hence by multiplying each of the digested constituents of a feed by its corresponding factor, and adding up the results we obtain the energy values of the feed. For our present purpose it is not necessary to reduce the pounds of each of the digestible constituents to grams as the actual energy value is not essential. So in making up the following table we have considered one pound to be equal to one gram. Then by multiplying the pounds of digested protein by 4.1, the pounds of digested fat by 9.3 and the pounds of digested fibre and carbohydrates by 4.1, we obtain a fair comparison of the feeds, though not the actual energy value of each of them.

Comparative value of 100 pounds of each feed.

Feed.	Steer No. 1.	Steer No. 2.	Average.	Nutritive ratio.		
				No. 1.	No. 2.	Average
Oat dust	224,880	223,319	224,099	1:5.1	1:4.9	1:5.0
Barley dust	193,926	188,017	190,971	1:4.37	1:4.88	1:4.62
Corn meal	354,845	331,613	343,229	1:8.04	1:8.61	1:8.32
Wheat bran	256,850	270,049	263,449	1:4.52	1:4.83	1:4.68

Wheat Bran is to-day selling at Mr. Goldie's Flour Mills at Guelph, at about $20.00 per ton. If we take this feed as the standard and compare the other feeds with it from the energy values obtained above, we have the following values per ton for each of the feeds analysed:—

Wheat Bran, $20.00; Oat Dust, $17.00; Barley Dust, $14.75; Corn Meal, $26.00.

It would not, however, be fair from a practical agricultural standpoint to value a feed only on its power to produce energy. We must also consider its fertilizing value after being fed. The quality of the manure furnished by a mature animal is largely dependent on the quality of the feed fed. A mature animal neither gaining nor losing in flesh will void in the excrement nearly all the nitrogen and ash constituents furnished to it. Hence, by carefully saving all the solid and liquid manure, one is able to return to the land practically all the nitrogen, phosphoric acid and potash in the feed.

With growing animals, fattening animals, or dairy cows this is not possible, as a perceptible quantity of the nitrogen goes to build up animal tissue or furnish milk; and some of the ash constituents are used to build up bone, etc. But in this experiment, and in any case where a maintenance ration is fed to mature animals, practically all the nitrogen, potash, and phos-

phoric acid may be returned to the soil. Hence, in determining the values of these feeds, we have considered that the three elements named were excreted wholly and could have been used as fertilizers.

According to the report of the Department of Inland Revenue of Canada, nitrogen in farmyard manure is worth about 15 cents per pound, phosphoric acid, as P_2O_5, is worth 5 cents, and potash, as K_2O, is worth 5 cents per pound.

The following table gives the fertilizing value of each of the feeds used in the experiment:—

Fertilizing value of one ton of each feed.

Feed.	Nitrogen.		Phosphoric Acid, P_2O_5		Potash, K_2O.		Total value.
	lbs.	Value.	lbs.	Value.	lbs.	Value.	
Wheat bran	48.72	$7 32	57.80	$2 89	32.30	$1 .61	$11 .82
Oat dust	45.50	6 83	18.48	92	15.52	78	8 53
Barley dust	45.06	6 76	23.52	1 18	30.30	1 52	9 46
Corn meal	37.22	5 58	15.02	75	13.64	68	7 01

By combining the preceding tables, thus including both feeding and manurial values, and taking Wheat Bran as the standard at $20.00 per ton, Oat Dust is then worth $16.00 per ton, Barley Dust $15.20, and Corn Meal $20.75 per ton.

The Corn Meal was made by grinding whole corn and sold f.o.b. at the mill for $19.00 per ton.

Barley Dust contains all the hulls of barley, and our experiment shows it to be very high in crude fibre. For feeding purposes alone it is worth $5.25 per ton less than Wheat Bran and $2.25 per ton less than Oat Dust. Nevertheless it sells readily for $18.00 per ton.

Oat Dust, on the other hand, sells for $8.00 per ton and is worth for feeding purposes alone, when compared with bran, $17.00 per ton.

These facts lead us to conclude: First, that the prices charged for by-products from the mills are no indication of their actual feed value.

Second, that the by-products from different mills must vary greatly in composition, and in many cases the market price is set from the inferior article.

Third, that the value of Oat Dust depends wholly on the amount of hulls it contains; that is, if the hulls are sifted out and sold as a separate by-product, then true Oat Dust is a valuable cattle food.

SOIL INVESTIGATION:

For some years past Professor Harcourt has directed the co-operative experiments with fertilizers on swamp soils, with the idea of ascertaining by this means their special requirements, and it was agreed last spring that he should continue this work until the end of this season and report upon it. During his absence this summer, I looked after the distribution of the fertilizers and issued instructions as to their application. In the spring I secured the names of a number of intelligent farmers who wished to conduct similar experiments in their own localities and supplied them with the materials and instructions necessary. As this latter part of the work is but in the initial stage I am unable to make any lengthy report on it.

In connection with these experiments I respectfully ask that you assign me two or three acres of land on the College farm, where I shall be able to carry out the work under my own supervision with the object of eliminating, as far as possible, errors that would seem almost unavoidable with the individual experimentalist. In my opinion such work would be of the highest value to the practical agriculturist. Experiments conducted on scattered areas on the farm are not to be relied on for satisfactory data on which to base conclusions. It is necessary to have the conditions as uniform as possible and to carry them out on the same plots for a number of years with different crops. I would, therefore, request your earnest consideration of this matter.

Water Analysis.

During the past season we have had a number of requests from different parts of the country for analytical reports on water for drinking purposes. Most of these we have referred to Dr. John A. Amyot, Bacteriologist and Analyst of the Provincial Board of Health. Most of the samples analysed in our laboratory were found to be quite suitable for domestic purposes.

Respectfully submitted,

W. P. GAMBLE

PART VIII.

THE PROFESSOR OF VETERINARY SCIENCE.

To the President of the Ontario Agricultural College.

SIR,—I have the honour to herewith submit my annual report for the year 1907-1908.

CLASS ROOM.

The class room work was much the same as usual.

First Year. To this class during the fall term I gave a course of lectures on Veterinary Anatomy, briefly, though somewhat comprehensively considering the anatomy of the horse and the ox. When possible we verified description by the examination of the skeleton of the horse or the living animal. During the afternoon lectures we discussed the erection of horse stables as regards site, drainage, material, ventilation, kinds and arrangements of stalls, both single and box; floors, mangers, feed boxes, etc.; also the general care of horses as regards feeding, watering, grooming, working, etc., and the care of harness, saddles, vehicles, etc. This was followed by a course of demonstrations in scoring and judging horses of different breeds and classes.

During the winter term I gave a course of lectures on "Veterinary Materia Medica," in which we discussed the properties, actions, uses and doses of the different drugs used for the prevention and cure of the ordinary diseases of farm stock. We also discussed the different methods of administering medicines, with the advantages and disadvantages of each.

Second Year. The class room work for this class during the fall term consisted in a consideration of the causes, symptoms and treatment, both preventive and curative, of the common diseases of farm stock, with frequent reference to the proper way of feeding, watering, working, etc., in order to prevent disease. As far as possible we illustrate the point under discussion by examining a living horse, the skeleton or individual bone.

During the winter term I gave a course of lectures on "Veterinary Obstetrics," treating of the phenomena of conception, gestation and parturition: the various causes of sterility and the means by which some of them can be removed; the diseases of both sexes due to the act of reproduction; the general hygienic treatment of pregnant females; the causes of difficult parturition with the means for their removal; the causes, symptoms and treatment of the diseases of both dam and offspring incident to and following parturition until the latter has reached that age at which he can exist independent of the former. We pay special attention to the diseases of the young.

During the afternoons I gave a course of lectures and demonstrations on the practical methods of handling horses and colts, securing animals for minor operations and the performance of the same, as dissecting out tumors, dressing and stitching wounds, checking hemorrhages, lancing abscesses, castrating, dressing teeth, etc., applying blisters and bandages. I illustrated the methods of applying bandages, stitching wounds, administering medicines in the different ways and forms, passing a probang in the ox, puncturing an ox in case of excessive bloating, etc. I also gave to this class

a course in "horse judging," using for the purpose the horses of the institution, those in my own stable, borrowing some and visiting neighbouring studs.

Third and Fourth Years. With these classes I continued the course in horse judging, using our own horses, those of local studs and visiting studs at considerable distance.

Special Dairy Class. To this class I gave a short course of lectures on the causes, symptoms and treatment of the various diseases to which dairy stock is subject.

Short Course in Stock Judging. This course, which was held in January, was well attended, and as usual, those who attended expressed themselves as being well satisfied. We gave a practical course of scoring and judging horses of the different breeds and classes. In this I was ably assisted by Geo. Grey, Esq., of Newcastle. I take this opportunity of publicly thanking those gentlemen who so kindly supplied horses for scoring and competition in the different classes, viz.; Messrs. Sorby, McCannell, Atchieson, Hurley, McPherson, Dr. Short and others.

Breeding Horses.

Our three Clydesdale mares were all in foal and each produced a living foal. Two of these continued to do well, but the third died of acute diarrhoea when about 36 hours old.

Injuries and Diseases of Stock.

In the different classes of stock we had cases of the ordinary diseases, but no fatalities except in newly born animals.

Respectfully submitted,

J. H. REED.

Guelph, November, 1908.

PART IX.

THE PROFESSOR OF DAIRY HUSBANDRY

To the President of the Ontario Agricultural College.

SIR,—I beg leave to submit my eighteenth annual report of the Dairy Department of the College.

The teaching work for the year has been along lines similar to those followed in other years, except that for the special dairy class, double the time formerly given, was devoted to laboratory work in Dairy Chemistry and Dairy Bacteriology. This enabled the class to better grasp the principles of chemistry and bacteriology as applied to dairying. In former years students complained that they were given too much in the short time allotted to laboratory instruction.

We are indebted to the Chemical and Bacteriological Departments for assistance rendered with the special dairy classes and also to several of the College Professors and their Assistants for special lectures.

The Chemical and Live Stock Department have co-operated with us in experimental work during the year. We thank them.

I am specially indebted to my assistants Messrs. Stratton, Taylor, Ralph and Wood, and also to Miss Lillian Sparrow, stenographer and accountant, for valuable help given during the year. The Instructors of the Dairy School have done good work in the Short Courses, and I take this opportunity of thanking them for their co-operation in making the Short Course helpful and profitable.

The total attendance at the Short Courses in dairying was 78.

Only one person made application for a Dairy Diploma, during the year. This was Mr. Wm. A. Freeman of Condersport, Pa., U.S.A., who attended the Short Course in 1907.

A change in our method of obtaining raw material (milk and cream) for experimental and teaching purposes was inaugurated on April 1st, 1908. Beginning on that date we charged four cents per pound fat for hauling the cream and making the cream into butter. Where patrons delivered their own cream, a charge of three cents per pound fat was made for manufacturing. In the cheese branch of the dairy we handled the milk and made it into cheese for 1½ cents per pound of cheese. Where patrons delivered their own milk, one cent per pound of cheese was charged for making.

The results were very satisfactory to all concerned in the butter branch. In the cheese, owing to the relative high price of butter, a number who started sending milk for cheese-making either changed to sending cream or dropped out altogether, so we were short of milk for experimental cheese work during most of the season.

From our experience during the past year, I would recommend that we continue the present plan of charging a rate for manufacturing butter, but that we purchase the milk outright for cheese-making.

In order to obtain milk for cheese-making we are obliged to pay a price equal to what farmers can get, if sold to milk dealers in Guelph. As a rule, we cannot make this much out of milk made into cheese. The difference

would be a financial loss amounting to from 10 to 25 cents per 100 lbs., but this would be amply compensated for in the experimental and investigational work conducted and in having a sufficient supply of milk for teaching students practical cheesemaking.

Mr. Stratton has had direct charge of the manufacturing and selling part of the dairy work during the year, acting as Manager for the Patrons and also as representative of the Dairy Department in this part of the dairy work. The following table gives a summary of the year's transactions so far as manufacturing and dealing with patrons is concerned.

SUMMARY OF MANUFACTURING ACCOUNT, DEC. 1, 1907, TO NOV. 30TH, 1908.

Month.	Milk and cream received.		Milk mfd. into		Manufactured		Paid patrons.	Received
	Milk.	Cream.	Cheese.	Butter.	Cheese	Butter.		
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$ c.	$ c.
December, 1907	46,327	7,084	2,923	43,404	303	3,942	1,222 54	1,191 08
January, 1908	87,061	12,901	30,747	54,563	2,938	5,801	2,156 28	1,575 86
February	52,841	8,887	28,791	25,020	2,603	4,012	1,453 57	1,887 07
March	49,054	12,202	20,463	29,372	1,856	4,944	1,593 61	2,182 16
* April	26,400	13,355	22,951	3,440	2,093	4,106	1,419 18	173 70
May	31,339	19,212	26,359	4,980	2,401	6,128	1,782 83	241 77
June	38,420	37,783	33,634	4,786	3,221	12,403	2,760 67	457 42
July	30,467	33,996	23,830	6,637	2,171	10,926	2,480 94	387 11
August	29,136	32,138	18,934	10,202	1,773	10,833	2,592 33	373 11
September	23,156	31,303	17,160	5,996	1,638	10,307	2,465 77	352 50
October	13,413	23,211	13,413	....	1,348	7,403	1,906 71	259 50
November	6,034	16,436	6,034	....	620	5,137	1,400 57	176 26
Totals	433,648	248,508	245,239	188,409	22,565	85,942	23,235 00	9,257 54

*Beginning April 1st, a rate was charged patrons for manufacturing instead of purchasing the milk and cream.

CONDENSED MILK.

Owing to the rapid development of the condensed milk industry, I beg leave to recommend that a small condensed milk plant be installed at the Dairy of the College as soon as possible. This is a phase of dairying that is likely to assume large proportions in the near future. There is likely to be a good demand for the products from the milk condenseries and also for skilled men to operate them. We visited three of these plants during the week of November, 1908, and found in two cases, buildings and plants costing from $100,000 to $150,000 each. The three factories were receiving an average of over 100,000 lbs. milk daily for which they were paying the farmers $1.50 per 100 lbs. As these plants are backed by plenty of capital, are operated by skilful workmen, and because they utilize *all* of the milk solids, instead of practically wasting half the solids in milk as is the case in cheesemaking, we look for a strong development of the milk condensing branch of dairying and a corresponding decrease in the cheese industry.

OFFICIAL TESTING OF COWS.

On May 1st, Mr. C. S. Wood, formerly Herdsman in the Dairy stable of the College, was appointed to the position of Official Tester in the Dairy Department of the College, and will now have charge of that branch of the

work. As most of the official testing is done during the winter, the season was practically over before Mr. Wood was appointed. During the summer he acted as assistant in experimental work and in the college creamery. He took full charge of the testing of the nine cows, reported on in another place, for milk, fat and casein and also of the "whey butter" experiments. Mr. Wood also acted as Instructor in churning for the Second Year classes during the fall term.

During January, February and March, practically all his time will be given to official test work. We also engage several others, having at times, five or six testers out at one time in various parts of the Province. All expenses are paid by the owners of the cows. In the case of Mr. Wood, those to whom he is sent will pay his travelling expenses and in addition a sum of two dollars per day for his services, which amount is paid to the College.

The following table shows the names of those for whom testing was done during the year, also the number of cows tested. All of the cows tested were Holsteins.

Name and Address.	No. of cows.
Rivers, Walburn, Foldens,	4
Clare, Herbert, Norwich,	2
Richardson, J. W., Caledonia,	9
Bollert, H., Cassel	1
Teeple, A. H., Currie's Crossing	4
Rife, David, Hespeler,	4
Rice, Geo., Tillsonburg,	4
Bailey, J. W., Nober,	2
Haley, M. H., Springford,	7
Pettit & Son, Burgessville,	2
Rettie, James, Norwich,	5
Clemons, G. W., St. George,	3
Smith, R. T., Millgrove,	2
Buckrell, Jno.,	1
Hicks, R. F., Newtonbrook,	3
Gilroy, G. A., Glen Buel,	6
Flatt, D. C., Millgrove,	1
McKenzie, Geo., Thornhill,	1

Name and Address.	No. of cows.	
Hartley, Thos., Downsview,	5	
Lammiman, T. J., Curries,	1	
Row, Fred, Curries,	2	
Kelly, Byron, Kelvin,	3	
Manhard, G. H., Manhard,	3	
Lillie, Orlands, Wesport,	1	
Manhard & Lillie,	2	
Mason, W. E., Tyrrell,	3	
Brown, W. W., Lyn,	2	
Stewart, Jno. W.	2	
	—	85
30 day tests:		
Manhard & Lillie,	1	
Brown, W. W., Lyn,	2	
Gilroy, G. A., Glen Buell	2	
	—	5
1 day test:		
Manhard & Lillie,	1	

Testing Milk and Cream.

Since my last report we have tested 73 samples of milk and 95 samples of cream for fat, making a total of 168 samples which have been sent by mail or been delivered to us to test. A number of samples are broken during transit in the mail, hence great care is needed in packing the samples. The bottle should be placed in a special mailing tube or a stiff card board or wooden box which will prevent breaking of the bottle. In addition to the loss of the sample, there is a decided objection to having samples broken in the mail on the part of the Post Office authorities. Our attention has been called to this by the P.O. people and they have asked us to warn all parties of the danger of spoiling mail matter through having milk spilled on it after the bottle is broken.

Casein in Milk.

Previous to the year 1907 no short method was known for determining the amount of casein in milk. Dr. E. B. Hart of the Wisconsin Experiment Station brought out the Hart Casein Tester that year, and it ought to do for the cheese industry what the Babcock fat test has done for the cream-

ery industry. It is somewhat strange that the successor of Dr. Babcock should, seventeen years after the advent of the fat test evolve a second important test, viz., one for the casein of milk.

PRINCIPLES OF HART CASEIN TESTER. According to the inventor, as given in the twenty-fourth Annual Report of the Agricultural Experiment Station of Wisconsin, p. 119, the principles involved in the method are:

1. "A tube and scale whereby percentages of casein in the milk are read directly."

2. "Establishment of a proper volume of milk to be used that will conform to the tube and scale adopted, allowing percentage of casein to be read directly."

3. "The precipitation of the casein by dilute acetic acid."

4. "Agitation of the precipitate with chloroform to remove the fat."

5. "The application of a definite centrifugal force in order to mass the casein into a pellet."

6. "Reading the per cent. of casein."

OUR EXPERIENCE WITH THE HART CASEIN TEST. We purchased early in 1908 from the Creamery Package Co., Chicago, a six bottle casein tester at a cost of $64. The chief difficulties we have had in operating the test were, breaking of bottles and expense for chloroform. As ours is a hand machine we also found that to maintain a speed of 2,000 revolutions per minute was rather tiresome. We wrote the manufacturers of the machines regarding the breaking of bottles, but they were unable to offer any explanation as to why so many bottles should break without any apparent cause. Owing to the fact that the directions say, "the chloroform should be of the best quality," we purchased at first the purest form which cost $2.50 per pound. As we found this rather expensive, we wrote Dr. Hart, who said that a quality of chloroform which would give satisfactory results could be got in the United States at 40 to 50 cents per pound. On making inquiry among local druggists the cheapest article we could get was 75 cents per pound in one pound lots and 70 cents per pound in ten pound lots. The manufacturers are now prepared to furnish a small electric motor to operate the Hart Casein tester as well as the Babcock tester, at a cost of twenty-four dollars.

MAKING THE TEST. The bottles are hung in a suitable rack for filling. Two cubic centimeters of chloroform are placed in each bottle, then 20 cc. of .25 per cent. solution of acetic acid at 70 degrees F., are put in on top of the chloroform. Five cc. milk at 65 degrees to 75 degrees F., are next added, the thumb is placed over the mouth of the bottle and the whole is inverted, then shaken for 15 to 20 seconds. This enables the chloroform to dissolve the fat. The bottles are then placed in a 15 inch diameter centrifuge and whirled for 7½ to 8 minutes at a speed of 2,000 revolutions per minute. In order to insure uniform and correct speed, a metronome is furnished with the machine. After whirling, the bottles are removed and placed in a rack supporting them in an upright position where they are allowed to stand for ten minutes. The casein is in the form of a pellet which is easily read on the graduated scale of the bottle to one-tenth of one per cent. After reading, the bottles are emptied and washed when they are ready for use again.

EXPERIMENTS RELATING TO CASEIN AND CASEIN TESTER.

HART CASEIN TESTER COMPARED WITH CHEMICAL ANALYSIS. While we had every confidence that the inventor was satisfied that the casein tester was practically accurate, otherwise he would not have given it to the public, we arranged with the Chemical department for a series of comparative tests in the months of May, June and July. Altogether 22 tests were made comparing results got by the Hart tester with chemical analysis. The samples

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were taken from the College herd milk, from the vat in the cheese room which represented the mixed milk from about a dozen patrons, and from three individual patrons' milk.

Source of Samples.	No. of Samples.	Average p.c. fat in milk.	Average p.c. casein in milk.	
			Hart Casein Tester.	Chemical analysis.
College herd	7	3.80	2.370	2.370
Vat	7	3.67	2.400	2.410
Patron No. 1	2	4.40	2.550	2.627
" 2	5	3.54	2.316	2.334
" 3	1	3.80	2.400	2.527
Totals and averages	22	3.842	2.4072	2.4536

The average difference on the 22 samples between the results got by the Hart casein tester and by chemical analysis was .0464 per cent. higher by chemical analysis. In only one case was the difference more than .2 per cent. In most cases the difference was less than .1 per cent. This is a remarkable showing and is even closer than comparative results got with the Babcock tester for fat as compared with chemical analysis.

COMPOSITE SAMPLING. In order to make the test of practical use in cheese factory work it ought to test composite samples satisfactorily, or some modification of the ordinary fat methods of composite sampling would have to be resorted to.

In the 24th Annual Report of the Wisconsin Station, p. 130, the inventor says "The preservatives in all cases but that of the potassium bichromate had a pronounced influence on the test after twenty-four hours' standing, and should never be used when this test is to be applied."

On p. 132 of the same report we read: "From the data at hand it is certain that the best results are obtained on either unpreserved milks or on milks preserved over but short periods of time with potassium bichromate in the above dilution." (1 tablet to 300 cc. of milk.)

TABLE SHOWING COMPARATIVE RESULTS FROM DAILY AND COMPOSITE FAT AND CASEIN TESTS.

Source of Samples.	No. of days for Comp. Samples.	Milk.	Aver. Fat.		Fat Cr.			Av. Casein.		Casein Cr.		
			Daily.	Comp.	Daily.	Comp.	Differ-ence.	Daily.	Comp.	Daily.	Comp.	Differ-ence.
		lbs.	p.c.	p.c.	lbs.	l s.	lbs.	p.c.	p.c.	lbs.	lbs.	lbs.
O.A.C.	3	272	3.81	3.8	10.39	10.33	.09	2.56	3.0	6.97	8.16	1.19
"	4	545	3.48	3.5	19.02	19.07	.05	2.34	2.6	12.79	14.17	1.38
"	5	976	3.92	4.0	38.09	39.04	.95	2.73	3.1	26.55	30.25	3.70
No. 4	2	110	3.20	3.2	3.52	3.52	.00	2.23	2.6	2.46	2.86	0.40
"	3	162	3.59	3.5	5.82	5.67	.15	2.25	2.5	3.65	4.05	0.35
No. 3	3	502	4.24	4.0	21.31	20.08	1.23	2.38	2.8	11.98	14.05	2.07
"	6	882	4.09	4.1	36.11	36.16	0.05	2.34	2.6	20.69	22.93	2.24
"	3	517	3.72	3.8	19.26	19.64	0.38	2.41	2.6	12.51	13.44	0.93
"	6	888	3.92	4.0	34.83	35.52	0.69	2.44	*2.5	21.67	22.20	0.53
"	6	866	4.14	4.1	35.88	35.50	0.38	2.56	*2.6	22.21	22.51	0.30
"	5	660	3.81	3.9	25.15	25.74	0.59	2.41	2.9	15.93	19.14	3.21
Averages	4.2	580	3.81	3.8	22.671	22.751	0.08	2.422	2.709	14.31	15.796	1.486

The milk from the College herd and from two individual patrons (Nos. 3 and 4) was used in the experimental work done by us for comparative results got by individual casein tests and composite sample tests, using bichromate of potash for preservative and keeping the samples from 2 to 6 days.

CASEIN IN INDIVIDUAL COW'S MILK BELONGING TO THREE DIFFERENT BREEDS OF DAIRY CATTLE.

Beginning May 1st, 1908, and concluding November 15th, 1908, the milk from nine cows, representing three breeds of dairy cattle, having three cows in each breed, were selected for an experiment to ascertain the variation in the casein in milk of different breeds as well as in the milk of animals belonging to the same breed. Incidentally the relation of casein to fat was determined and also the total pounds of milk, fat, and casein for a period of 199 days. The report is preliminary. The work will be continued until we have the results for at least one year—longer if possible. We aimed to have one cow nearly fresh; one, two or three months; and one six months or more in lactation at the beginning of the experiment. The same cows were used throughout the experiment except in one case. The following table gives the chief data relating to the cows used in the experiment.

Herd No.	Breed.	Age.	Date of Calving.	No. of days milking during experiment.	Total No. days milking for each breed.
76	Holstein	8 yrs.	Feb. 7, 1908.	199	468
111	"	3 "	May 15, 1907 Aug. 22, 1908	177	
128	"	7 "	Nov. 14, 1907 " 19, 1908	92	
66	Ayrshire	8 "	March 20, 1908	199	478
136	"	5 "	" 7, 1907	150	
133	"	4 "	Oct. 5, 1907 " 10, 1908	128	
131	Jersey	7 "	" 9, 1907	199	532
*132	"	7 "	July 6, 1907	199	
129	"	12 "	Sept. 12, 1907		
123	"	4 "	July 3, 1907 Oct. 20, 1908	134	

* No. 132 aborted on June 17, when No. 129 was substituted.

PLAN OF EXPERIMENT. The milk from each cow was weighed morning and evening and samples were taken once a week from each of the milkings for the day. The samples of morning and night were mixed together and tested for the fat and casein the following morning. The fat was determined with the Babcock tester and the casein by the Hart Casein method. The total pounds of milk, fat, and casein given during one week by each cow and by each breed were calculated by multiplying the pounds of milk, fat and casein given in one day, by seven. The monthly and season totals are the sums of the weekly calculations. To give the weekly and monthly details for each cow in the experiment would occupy too much space in the report, hence we give but the summary of the results for each cow and for each of the breeds during the 199 days of the experiment.

Summary of Results.

Herd No. of Cow.	Breed.	Lbs. milk.	Aver. p.c. fat.	Lbs. fat.	Aver. p.c. casein.	Lbs. casein.	No. of days milking during experiment.
76	Holstein	8,000	3.34	267.52	2.09	167.49	199
111	"	4,054	3.50	141.89	2.13	86.64	177
128	"	2,252	3.47	78.30	2.41	54.37	92
Totals and Average	"	14,306	3.41	487.71	2.15	308.50	468
66	Ayrshire	6,306	3.91	246.62	2.40	151.40	199
136	"	3,538	3.97	140.39	2.04	72.21	150
133	"	3,221	3.83	123.63	2.75	88.74	128
Totals and Average	"	13,065	3.90	510.64	2.39	312.35	477
131	Jersey	3,265	4.11	144.37	2.54	83.10	199
132 and 129	"	2,747	5.08	139.70	2.59	71.28	199
128	"	1,405	5.03	70.79	2.53	35.65	134
Totals and Average	"	7,417	4.78	354.86	2.56	190.03	532
Totals and Averages for 9 cows.	3 Hols. 3 Ayr. 3 Jerseys	34,788	3.89	1,353.21	2.33	810.88	164

It will be noticed in the preceding table that the Holsteins gave the most milk during the period of the experiment, but the Ayrshires were a close second in quantity of milk and were ahead in total pounds of both fat and casein. The average percentages of fat and casein were highest in the Jersey cow's milk. This ought to be satisfactory to all concerned as each of the breed representatives were ahead in something.

The average pounds of fat in the Holstein milk for each pound of casein was 1.58; in the Ayrshires the relative proportions were 1.63 lbs. fat per pound of casein and for the Jerseys 1.86.

The relation of milk casein to milk fat by breeds was Holsteins .63 lbs. casein per pound of fat in the milk; Ayrshires .61 and Jerseys .53.

We thus see that the pounds of fat per pound of casein and the pounds of casein per pound of fat in the milk are very similar in the case of both Holstein and Ayrshire milk, assuming that the cows in the test are fair representatives of the breeds, but that the milk from the Jerseys has a comparatively high proportion of fat to the casein and of course the reverse of this a rather low proportion of casein to the fat in their milk.

Variation in Percentages of Fat and Casein. What range of fat and casein (more particularly casein, as that is the special point under investigation) may we expect in cows' milk? The following table shows the highest and lowest percentages of fat and casein in the milk of the nine cows under investigation grouped according to breeds, together with notes regarding the circumstances under which these extreme tests occurred.

Among the Holsteins the extreme variation in the percentage of fat in one day's milk was from 3.2 to 4.6. The casein varied from 1.8 to 3.6, but the extremely high tests were at a time when the cows were nearly dry and were being milked but once a day.

The Ayrshires varied in fat percentage from 3.3 to 5.4 and casein, 2.1 to 4.2. The high tests for fat and casein in this case also were just before the cows went dry.

Breed.	Herd No.	Per cent.	Comments.
Holstein :			
Highest fat.....	111	4.6	Cow on poor pasture and nearly dry, July 20.
Lowest fat......	76	3.2	Cow tested 3.2 several times during experiment.
Highest casein..	111	3.6	Cow on pasture and nearly dry 3.2, next highest No. 128 nearly dry.
Lowest casein...	111 & 76	1.8	Both cows several times tested 1.8 and 1.9.
Ayrshire :			
Highest fat.....	136	5.4	Cow on pasture, nearly dry.
Lowest fat....	133	3.3	Test made Oct. 18, cow calved Oct. 10. Pasture and silage.
Highest casein..	136	4.2	Test made same date as high fat test.
Lowest casein...	113, 136 & 66	2.1	No. 136 tested 2.1 three times ; No. 133 once and No. 66 six times.
Jerseys :			
Highest fat.....	123	6.4	Cow in stable receiving silage, mangels, hay, bran and molac meal.
Lowest fat......	131	4.0	
Highest casein..	132	3.6	June 3, cows on pasture, bran and molac feed. Milk was uniformly high in fat (5.2 to 5.8) and in casein (3.0 to 3.6).
Lowest casein...	123	2.1	Calved Oct. 20. Test Nov. 1. Silage, mangels, hay and meal.

The range in tests for the Jerseys were from 4.0 to 6.4 per cent. fat and 2.1 to 3.6 per cent. casein. The average *percentages* of fat and casein were high in the Jersey milk, as is shown in the previous table, but the *total* pounds of fat and casein were considerably lower for the Jersey group than for either of the other two groups, due to a rather low yield in weight of milk—a little over one-half the weight given by each of the others.

Effect of Lactation on Per Cent. Casein in Milk. During the period of the experiment, one Holstein, two Ayrshires and one Jersey freshened. One Holstein, one Ayrshire and one Jersey milked continuously during the whole period of the test from May 1st to Nov. 15th, or 199 days. We shall thus be able to make comparisons as to the effect of lactation on the milk casein, when cows are "drying off" and with the same cows when "fresh" and also with cows which have been milking throughout the experiment. If we select the first and last weeks of the periods of lactation for the cows freshening during the experiment and the first and last week of the period of the experiment for the continuous milkers, and also take the average of three weeks at the end and beginning of the lactation, and for the period of the test, we shall have a fair knowledge of the effect of lactation on the percentage of casein in the milk of the cows under consideration and under the conditions given in the experiment.

In the case of the cows having a continuous lactation during the experiment the table shows the percentages of fat and casein for the first and last weeks and also, average of first three and last three weeks of the experiment. In the case of cows which were dry during a portion of the experiment, or those having an intermittent period of lactation, the table shows the tests for the first and last weeks of the two periods of lactation and not the weeks at the beginning and close of the experiment.

Effect of Lactation on Per cent. Fat and Casein in Milk During 199 Days. May 8th, to Nov. 15th, 1908.

Herd No.	Breed.	Lactation.	Average p. c. fat in milk for weeks				Average p. c. casein for weeks			
			1st	Last	1st 3	Last 3	1st	Last	1st 3	Last 3
76......	Holstein....	Continuous	3.2	3.5	3.2	3.6	2.3	2.9	2.1	2.23
66	Ayrshire ...	"	3.5	4.2	3.6	4.13	2.6	2.5	2.5	2.50
131......	Jersey......	"	4.2	4.7	4.13	4.60	2.8	2.6	2.66	2.60
111......	Holstein....	Intermittent	3.3	4.4	3.40	4.33	2.1	3.6	2.00	3.00
136......	Ayrshire ...	"	3.6	4.8	3.76	5.06	3.0	3.6	2.63	3.80
133......	" ...	"	3.3	4.4	3.50	4.33	2.5	3.6	2.30	3.36
123......	Jersey......	"	4.4	5.0	4.43	5.40	2.1	2.7	2.16	2.90
Average	....	....	3.64	4.42	3.71	4.49	2.48	2.97	2.33	2.91

Table Showing Average Percentage of Casein in Milk by Months.

Month.	No. of tests.	Average p.c.casein.	Month.	No. of tests.	Average p.c. casein.
May	27	2.72	September...........	18	2.16
June	35	2.73	October	13	2.25
July	31	2.60	November...........	23	2.33
August	22	2.30			

The foregoing tests indicate that the milk of these nine cows in the months of May and June averaged highest in percentage of casein; the milk in the month of July was slightly lower, followed by quite a decided drop in August and September, with a gradual increase for October and November. We should not care to place too much emphasis on this part of the work as it is possible that other factors than the month, or season may have been more potent causes of a variation. The work would need to be extended to a large number of cows under various conditions and covering a series of years before definite conclusions could be drawn.

The foregoing table also gives a basis of comparison as to the relative percentages of casein in milk when cows are in the stable spring and fall, with milk from the same cows when on pasture and receiving in addition some bran and molac feed. (One Cow, No. 76, was kept in the stable, beginning July 5th., and fed green clover, hay, bran and molac during July and August; mangels, silage, bran and molac during September and October.)

In the month of May, cows were in the stable when the milk averaged 2.72 per cent. casein. During November the cows were again in the stable and the average percentage of casein was 2.33. The average percentage of casein in the milk, when the cows were out of doors most of the time and receiving some meal in the form of bran and molac in addition to pasture or green feed, was 2.41.

By using the same methods we have a comparison between the effects of a ration composed of corn silage, poor hay, bran and molac in the spring, when the casein tests averaged 2.72, with a ration composed of silage,

mixed hay, bran and mixed meal fed during November when the cows were in the stable and when the average percentage of casein in the milk of the nine cows was 2.33. During the summer (June to October inclusive) when the cows were on pasture—sometimes poor on account of the drought—with some meal in addition, the casein in the milk averaged 2.41 per cent.

We would emphasize, however, that it will not be wise to lay too much stress on these points owing to the limited number of cows, and of the few tests made.

Relation of Casein to Fat in Herd Milk. During the months of April to October inclusive we aimed to take a sample, once a week, from each patron's milk delivered at the cheese room. Some of the patrons dropped out for a time, or altogether, so that only three patron's milk were tested weekly throughout the season. The variation in the average individual tests by months of the fat and casein in each of three patron's milk is given for seven months; two patrons for six months; and one for five months, in the following table:

Month, 1908	Patron No. 3		Patron No. 4		Patron No. 5		Patron No. 8		Patron No. 10		Patron No. 11		Av.
	Fat	Casein	Fat	Casein	Fat	Casein	Fat	Casein	Fat	Casein	Fat	Casein	Casein
	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
April....	3.40	2.36	.....	......	3.36	2.23	3.90	2.20	3.40	2.26	......	......	2.26
May....	3.43	2.28	3.32	2.24	3.53	2.35	4.12	2.46	3.60	2.28	......	......	2.32
June....	3.80	2.50	3.30	2.27	3.47	2.30	3.95	2.50	3.52	2.42	3.90	2.55	2.42
July....	3.70	2.25	3.35	2.05	3.35	2.25	3.60	2.10	3.60	2.20	3.85	2.30	2.19
August..	4.05	2.32	3.77	2.35	3.70	2.40	3.25	2.22	3.72	2.37	3.85	2.55	2.37
Septem'r.	3.95	2.45	4.05	2.40	3.53	2.53	3.32	2.15	3.67	2.27	4.70	2.67	2.41
October..	3.95	2.55	4.25	2.77	.....	......	3.72	2.47	3.97	2.55	4.32	2.82	2.63
Av. for season.	3.78	2.39	3.68	2.37	3.50	2.34	3.70	2.33	3.65	2.34	4.15	2.61	

The following table shows the average percentage of fat and casein for twelve patrons during the season. Some of these patrons did not send milk more than two months, while others continued during the whole season from April to October inclusive. Samples were taken from two to six times per month for testing fat and casein.

Patron.	Average p.c. fat for season.	Average p.c. casein for season.
College herd..........................	3.81	2.46
Patron No. 1..........................	4.51	2.61 (April and May only).
" 2..........................	3.54	2.32 (April, May and June).
" 3..........................	3.78	2.39 (7 months).
" 4..........................	3.68	2.37 (6 months).
" 5..........................	3.50	2.34 (6 months).
" 6..........................	3.60	2.26 (April and May).
" 7..........................	4.00	2.28 (" ").
" 8..........................	3.70	2.33 (7 months).
" 9..........................	3.80	2.75 (4 months, April to July).
" 10..........................	3.65	2.34 (7 months).
" 11..........................	4.15	2.61 (5 months, June to October).
" 12..........................	3.60	2.20 (2 months, June and July).
Average of all	3.79	2.40

Cheesemakers find that it usually takes less milk to make a pound of cheese in September and October, and more milk earlier in the season, particularly in the months of July and August. In order to see whether or not there was much difference in the percentages of casein in the average of individual patron's milk and also in the vat of milk as received by us during the season, we have averaged the percentages of fat and casein for each of the patrons by months and also the same for the vats of milk used in our regular experimental work during the season. As previously explained, samples were taken from each patron's milk about once a week, and from the vat as often as possible from April to October. Some eighty-four casein tests of vat milk were made during the season.

Table Showing Average Percentages of Fat and Casein by Months in Patrons' and Vat Milk.

Fat and Casein.	April.	May.	June.	July.	August.	Sept.	October.	Season.
Percentage of fat:	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
Patrons' milk.......	3.76	3.76	3.65	3.61	3.72	3.87	4.04	3.77
Vat milk...........	3.67	3.64	3.64	3.53	3.75	3.72	3.97	3.67
Percentage of casein:								
Patrons' milk.......	2.35	2.41	2.42	2.27	2.37	2.41	2.63	2.38
Vat milk............	2.30	2.28	2.46	2.31	2.40	2.45	2.61	2.39

Table showing Yield of Cheese per pound Fat and Casein in Milk by Months, as determined by Experiments in Preceding Table.

——	April.	May.	June.	July.	Aug.	Sept.	Oct.
Lbs. Cheese per lb. fat in milk..	2.48	2.51	2.63	2.61	2.49	2.63	2.55
Average p.c. fat in milk.......	3.67	3.64	3.64	3.53	3.75	3.72	3.97
Lbs. Cheese per lb. casein in milk	3.96	4.10	3.89	3.99	3.89	4.00	3.87
Average p.c. casein in milk....	2.30	2.28	2.46	2.31	2.40	2.45	2:61

Relation of Casein in Milk to Yield and Quality of Cheese.

Two series of experiments were conducted during the season to find the relation of casein in milk to the quantity and quality of cheese produced. In the first series, thirty-four experiments were made for which were used 38,737 lbs. milk testing an average of 3.64 per cent. fat, and 2.37 per cent. casein. The whey from all the lots tested an average of .204 per cent. fat. We aimed at making one experiment each week throughout the season or about four each month. Some months there were less and some more than four trials made.

The results are conveniently grouped by months in the next table.

TABLE SHOWING RELATION OF CASEIN IN MILK TO CHEESE YIELD BY MONTHS.

	April.	May.	June.	July.	Aug.	Sept.	Oct.
Lbs. Milk	5,463	12,776	6,788	2,332	3,815	4,060	3,503
Av. p.c. Fat	3.75	3.48	3.64	3.57	3.74	3.72	3.98
Lbs. Fat	204.46	445.13	247.54	83.29	142.84	151.17	137.95
Av. p.c. Casein	2.3	2.24	2.48	2.41	2.39	2.43	2.65
Lbs. Casein	125.64	286.76	168.33	56.35	91 33	98.88	93.12
Av. p.c. Fat in Whey	0.22	0.26	0.19	0.19	0.18	0.20	0.20
Lbs. Cheese	504	1,176	660	218	363	388	356
Lbs. Cheese per lb. Fat in Milk	2.46	2.41	2.66	2.61	2.54	2.56	2.54
Lbs. Cheese per lb. Casein in Milk	4.01	4.10	3.92	3.86	3.97	3.92	3.82
Lbs. Milk per lb. Cheese	10.83	10.86	10.28	10.69	10.51	10.46	9.84
Lbs. Cheese per 1,000 lbs. Milk	92.2	92 04	97.2	93.4	95.1	95.5	101.3

The average percentage of fat in the milk used for all the foregoing experiments was 3.64 and that of the casein, 2.37. The average pounds of cheese per pound of fat in the milk was 2.59 and per pound of casein 3.98. The average weight of milk required for one pound of cheese was 10.56 lbs. The average yield of marketable cheese was 94.6 lbs. per 1,000 lbs. milk.

The curds at dipping averaged 48.76 per cent. moisture; the green cheese contained 34.98 and the cheese when sold, 34.92 per cent. moisture in the samples tested, but not all were tested for moisture.

The cheese scored an average of 93.23 points out of 100 for quality.

COMPARATIVE TESTS ON THE INFLUENCE OF CASEIN IN MILK ON THE WEIGHT AND QUALITY OF CHEESE MADE ON SAME DAY.

In the previous experiments, all the milk delivered in one day was put into one vat and made into cheese in the usual way at various times throughout the season of seven months. In the following experiments, of which there were five, the milk was divided between two vats on the same day. In the one vat we aimed to have the milk from patrons delivering milk with a rather low casein content; in the other, milk of a high casein content. The differences were not so wide as we should have liked for these tests, but it seemed difficult to get sufficient milk of each to make a cheese.

After the milk had been divided into two nearly equal portions on the basis of previous tests for casein, the vats were tested for fat and casein and both handled as nearly alike as possible at the various stages of manufacturing into cheese. Altogether there were used 5,140 lbs. milk. The lots in the one vat averaged 3.51 per cent. fat and 2.32 per cent. casein. The other lots averaged 3.75 per cent. fat and 2.46 per cent. casein. The average difference in the percentage of casein in the milk of the two vats was but .14 per cent.—not sufficient, one might think, to make any appreciable difference in yield and quality of the cheese although the average yield of marketable cheese per 1,000 lbs. milk was 88.4 from the low casein milk and 94.5 from the high casein lots—a difference of 6.1 lbs.

There was very little difference in the moisture contained in the two curds, or in the cheese. The lots of cheese made from the milks containing the higher percentage of casein averaged 34.8 per cent. moisture in the marketable cheese, while the other lots averaged 34.4—.4 per cent. less. The weight of milk required to make a pound of cheese averaged 11.3 lbs. for the low casein lots and 10.58 lbs. for the higher casein vats.

There was practically no difference in the quality of cheese from the two vats. The low casein lots of cheese scored an average of 91.9 points out of 100, while the others (higher casein) scored an average of 91.7 points.

CONCLUSIONS.

As previously stated the present report should be considered as a preliminary one, on a comparatively new phase of dairy work; therefore we do not feel justified in attempting to draw too many, nor too hard and fast conclusions. Our work so far would seem to warrant the following:

1. The Hart Casein tester appears to be a simple and reliable method for determining the percentage of casein in fairly fresh milk, but is not adapted, in its present form, to testing composite samples, although fairly good results were got by using a small amount of bichromate of potash as a preservative in milk samples for about six days.

2. The claim for "high casein milk" which has been made for certain breeds of dairy cattle is scarcely borne out by the results of the experiments, although a great deal more work will be needed before the matter can be said to be fairly settled.

3. The variation in the percentage of casein in milk does not appear to be so great as is the variation in the percentage of fat in milk. Generally speaking, milk with a high percentage of fat contains also a high percentage of casein, but the increase of the casein is not relatively so great as the fat.

4. As cows advance in lactation they tend to increase in both the percentage of fat and casein in their milk. This is more marked when we compare the milk just before "drying up" with that given soon after freshening.

5. The evidence as to the effect of season on the percentage of casein in milk is somewhat conflicting. For the nine cows under experiment, the highest percentages of casein in the milk was found in the months of May, June and July. In the milk supplied by patrons to the cheese department, the highest percentages of casein were in June, September and October. The lowest average of the nine cows was in September, and the lowest average for the patron's milk was in July. During a couple of weeks in July, the yield of cheese in our cheese room was low and it was found that the milk contained a comparatively low percentage of casein at that time. So far as we know there was no special reason why the milk should have tested low in casein at that particular time.

The average casein tests of the vats of milk in the cheese room were lowest and fairly uniform for the months of April (2.3), May (2.28) and July (2.31). The highest vat tests were for June (2.46), September (2.45) and October (2.61). All the testimony seems to agree that the June milk is comparatively high in casein.

6. The cheese experiments confirm previous conclusions, viz., that the yield of cheese is not in proportion to the fat in the milk. The pounds of cheese per pound of casein in the milk was fairly uniform throughout the season, the extreme variation by months being 3.87 to 4.1. The variation in the percentage of casein in the milk of these experiments was from 2.28 in May to 2.61 in October.

7. The addition of the factor 2. to the percentage of fat in the milk, makes a fairly reliable basis for distributing proceeds of sales at cheeseries. At present, we do not think daily, or weekly testing of milk for casein is practicable in factory work, but a Hart Casein tester along with the Babcock tester ought to be a part of the equipment in every cheese factory, to be used as required.

Whey Butter.

During the past two years considerable interest has been revived in the "whey butter" question. We took this question up several years ago and as a result concluded that it would not pay for manufacturing. Owing to the high price of butter for the past two seasons, and the strong competition from the milk condenseries, cheesemakers have turned to whey butter as an added source of revenue to satisfy patrons and meet the competition which is forcing some cheese factory owners to resort to unusual practices, such as making whey butter, in order to hold their patronage. Many cheese factory owners are growing uneasy. We recently received a letter from the owner of two large factories asking about the future of the cheese trade and whether or not we considered it likely that the milk condenseries would drive the cheese factories out of business. The whole question looks like a serious one for cheese factory owners, of which "whey butter" is only a minor phase. Back of all this there is the growing conviction that present methods of operating cheese factories are not giving financial returns to the farmers which their investment of capital in, and labour spent upon, the work, entitle them to receive. We have not seen the last of the discussion.

The Experiments.

Owing to our limited supply of milk for cheesemaking we were unable to conduct the experiments in as satisfactory a manner as we should have liked. To do this work properly we should have had from 2,000 to 3,000 pounds of milk daily throughout the season, whereas our supply reached this point in the early part of the season only. Later, we were obliged to collect the cream for several days in order to obtain sufficient for a small churning.

The Live Stock department co-operated with us in feeding hogs on whey which contained the fat, and on similar whey from which the fat had been removed by means of a cream separator. This experiment also reduced the amount of whey available for separating and making into butter. (For a summary on this part of the work, see report of Prof. G. E. Day.)

The main points investigated by us in the dairy department were:

1. The yield of butter per 1,000 lbs. whey.

2. The quality of the butter made—when fresh and after keeping for sometime in an ice cold-storage.

3. The effect of pasteurizing the whey cream.

The Yield of Butter per 1,000 lbs. Whey. Three experiments were nade on May 4th, 11th and 18th, when the exact weights of milk and whey were obtained. After May 18th the weights of milk and whey were estimated as closely as possible. For the first three experiments, 6,963 bs. milk and 6,107 lbs. whey were used—an average of 2,321 lbs milk, and ,035 lbs. whey for each test. The percentages of fat in the milk were 3.8, .6 and 3.6, averaging 3.66 for the three experiments. The percentages of at in the whey before separating were .22, .23 and .3—an average of .26. he whey was separated at a temperature of 120°F. in two cases and at 88° n the other. The pounds of whey cream obtained were 12.25, 20.5 and 1.5 respectively. The respective percentages of fat in the cream were 38, 0 and 19. The percentages of fat in the whey after separating were .005, 01, and .005. After separating the cream was pasteurized in all three xperiments at a temperature of 170° F. After cooling, from 2 to 3 lbs. of actic acid culture was added to each lot and they were allowed to ripen or sour

in the usual way, and churned next day, at a temperature of 55° to 57° F. The acidity of the cream at the time of churning ranged from 3 to 5 per cent. The time required to churn ranged from 12 to 18 minutes. The percentage of fat in the buttermilk ranged from .125 to .3. Salt was added to the butter at the rate of 3/4 to 5/8 of an ounce per pound of butter. The yield of butter was an average of 2.75 lbs. per 1,000 lbs. whey. From the *6,963 lbs. milk used, there was made 16.85 lbs. butter, or an average of* 2.41 lbs. per 1,000 lbs. milk.

The percentage of moisture in the butter ranged from 11.35 to 12.30, and averaged 11.746 for the three lots.

Between May 18th and July 6th, six more experiments were made, in which the estimated weight of whey was 8,291 lbs. The milk averaged 3.62 per cent. fat, and the whey before separating .218. The average yield of butter per 1,000 lbs. whey (estimated) was 2.59. The average percentage of moisture in the butter was 11.526.

Taking the average of the two series of experiments we obtained 2.675 lbs. butter per 1,000 lbs. whey. Assuming that the average yield of butter is about 2½ lbs. per 1,000 lbs. whey, a factory having 10,000 lbs. whey daily might expect to make about 25 lbs. butter daily. Assuming further that the factoryman is allowed two cents per pound of butter for making the butter, he would earn 50 cents a day in such a factory, to say nothing about interest on investment in, and wear and tear of machinery. If these experiments are *a fair indication of the amount of butter which can be made from whey* under factory conditions, we scarcely see how it can be profitable except in the large factories, or where the whey cream from several cheeseries is sent to a central point and there made into butter, such as is being done at Picton, Ont.

THE QUALITY OF THE BUTTER. A sample of the butter from each experiment was wrapped in ordinary parchment butter paper and placed in cold storage at a temperature of 40° to 45°F., where it was kept from two to four months. It was scored when fresh and again at intervals of about one month during the season. Six lots were scored by the Creamery Instructors when on a visit to the College on June 13th; one lot was scored by Mr. Stratton and the remainder of the scoring was done by the head of the Dairy Department.

The following table gives the average of the scores of butter made in the two series of experiments and also for two experiments made July 18th and 27th, where the cream was collected for seven and six days respectively *before sufficient was obtained for a churning. The cream was kept in cold* storage after separating. The lots making up the churnings on July 18th and 27th were pasteurized the day before churning, lactic acid culture was added, and they were allowed to ripen in the usual way.

All the lots were given full score (10) for salt, hence this is not included in the table.

It will be noticed by the scores given to the whey butter that it averaged fairly well—would class as second grade butter when fresh and compared favorably with farm dairy butter as ordinarily offered on local markets.

We were also agreeably surprised at the keeping quality of the whey butter. After holding it under only fair conditions as to temperature, the butter still scored about 40 out of 50 points for flavor, at the end of one to two months.

It will be noticed that the grain and texture of the butter nearly always scored higher at the second and third scorings, than it did at the first. This

is probably due to the fact that the body became firmer after standing in cold-storage for a month or more. The tendency was for a somewhat greasy texture when first made.

TABLE SHOWING QUALITY OF WHEY BUTTER MADE, 1908.

Kind of Butter.	No. of Expts.	Av. Flavor (50)	Av. Grain (20)	Av. Color (15)	Av. Total (100)
(First Series)					
Fresh	3	44.	17.6	14.	90.50
1 month old	3	42.25	18.3	13.	89.25
2 " "	3	40.30	18.66	13.6	87.83
3 " "	3	38.30	19.	14.5	87.
(Second Series)					
Fresh	6	43.5	18.08	13.25	89.83
1 month old	6	41.75	18.5	13.58	88.83
2 " "	6	37.83	19.	13.50	85.33
(Third Series)					
Cream collected for seven days.					
1st score	1	44.	17.	14.	90.
2nd " (1 month old)	1	42.	19.	14.5	90.5
3rd " 2 " "	1	36.	19.	14.	85.5
Cream collected for six days.					
1st score	1	42.	18.	14.5	89.5
2nd " (1 month old)	1	41.	19.	14.	88.5

The lots made on July 18th and 27th scored particularly high in flavor when we consider that the cream was collected in small lots for seven days in one case, and for six days in the other. Not only was the first score for flavor comparatively high (44 and 42 out of a possible 50) but at the end of one month, one lot had decreased but two points and the other, only one point, in flavor. These results indicate fairly good keeping quality—in fact quite equal to ordinary creamery butter.

COMMERCIAL VALUE OF WHEY BUTTER.

We have another means of judging of the quality of the butter made from whey, viz., its commercial value, or value in dollars and cents. In order to ascertain its quality from this viewpoint, we sent lots from ten different churnings to four different grocers in the city of Guelph and asked them to give us an estimate of its market value. In order to be sure that the estimate was a fairly correct one, we requested them to pay us in cash the value of the butter.

Some were rather suspicious, and said that if the butter were in College wrappers they could pay more for it. Others said they would like to know the origin of the butter. In some cases we told them, in others we did not. Our object was to get as closely as we could an idea of the market value of the butter free from sentiment and prejudice, so far as possible. When butter was plentiful in Guelph we had difficulty in selling it at all, but when it was scarce we could have sold large quantities at about two or three

cents a pound under creamery prices. In the latter part of the month of July one man said he would handle all we could furnish at 22 cents per pound. We were receiving at that time 25 cents per pound for our regular make of creamery butter.

In order to be able to compare the relative prices received for whey butter and that obtained for creamery butter, we give the dates of sale and prices obtained during the time of the experiment.

Date.	Price received per pound for	
	O.A.C. Creamery Butter.	Whey Butter.
May 9th, 1908	30 cents.	26 cents.
June 10th, 1908	22 "	20 "
July 12th, 1908	23 "	16 "
July 21st, 1908	24 "	20 "
July 28th, 1908	25 "	22 "
Average five sales	24.8 "	20.8 "

It will be noticed by the foregoing table that the difference in price received for creamery and whey butter varied from 2 to 7 cents per pound and averaged 4 cents for the months of May, June and July. Whether butter was plentiful or scarce had more effect on the relative prices than did the quality of the butter. Butter, simply follows the general law of price in this respect. When an article is scarce, goods of poorer quality always more nearly approach the price paid for articles of good quality. When articles of a special kind are very plentiful, the difference between the prices paid for good and poor are greater, and in some cases it may be difficult to sell goods of poor quality at any price.

Effect of Pasteurizing Whey Cream for Buttermaking.

All the lots of cream except two were pasteurized at temperatures *ranging from 170°F., to 180°F. Unfortunately,* we did not have sufficient whey cream to divide one lot into two portions, treating one by means of pasteurization and the other by non-pasteurization, consequently we shall have to compare the two lots of unpasteurized butter made June 2nd and 11th with the lots made during the previous and succeeding weeks.

The lot made on June 2nd, scored 46 out of a possible 50 for flavor, when scored on June 9th. The lot made the previous week (May 26th) scored 40 for flavor on May 27th—the day after it was made. The lot made June 11th, scored 41 for flavor on June 13th. The whole milk on this date was judged "Good" whereas the milk on the two previous dates (June 2nd, non-pasteurized, and May 26th pasteurized cream) was marked "Fair." On June 17th the milk was "Fair"; the whey cream was pasteurized at 175°F., and the butter scored 46 on June 20th. Taking the average of the first scores in flavor of two lots pasteurized and two lots unpasteurized we get a score of 44 and 43.5 respectively— a difference of but half a point in favour of pasteurization. There was also very little difference in the other qualities—"grain" and "color".

From the foregoing very limited number of experiments it would seem as if fairly good whey butter may be made without pasteurization.

The relative keeping qualities of the lots pasteurized and unpasteurized are indicated in the following scores of four lots for flavor. The other qualities were so similar that it is unnecessary to give the details.

Kind of Butter.	When Made.	Date of Scoring.	Score for Flavor (50)
Pasteurized	May 26th.	May 27th.	40
Unpasteurized	June 2nd.	June 9th.	46
"	" 11th.	" 13th.	41
Pasteurized	" 17th.	" 20th.	46
"	May 26th.	" 13th.	42
		July 27th.	36
		Sept. 21st.	37
Unpasteurized	June 2nd.	June 13th.	42.5
		July 27th.	39
		Sept. 21st.	35
"	" 11th.	July 27th.	41
		Sept. 21st.	37
Pasteurized	" 17th.	July 27th.	42
		Sept. 21st.	33

One lot of the pasteurized butter lost six points in flavor between June 13th and Sept. 21st, while the other lost eight points between June 20th and Sept. 21st—an average of seven points for the two lots. The non-pasteurized lots made June 2nd and 11th lost 7 and 4 points in flavor, respectively, between the dates of first and last scorings—June 9th and 13th, and Sept. 21st, or an average of 5½ points as compared with 7 points lost by the pasteurized lots. However, one lot of the latter had been held for about four months before scoring for the last time, while the others were given the final scoring at the end of about three months.

Conclusions.

1. The average yield of butter per 1,000 lbs. whey was about 2½ lbs. It seems doubtful if it would pay to manufacture this amount of butter in the average small cheese factory. Only large factories, or where conditions are favorable for centralizing the whey cream, can afford to manufacture whey butter.

2. The quality of the butter was fair and can be sold readily, when there is a scarcity of butter, at from two to three cents per pound under creamery butter prices. When butter is plentiful, it is somewhat difficult to sell, except at considerably reduced prices.

3. The butter appears to possess fairly good keeping qualities so far as these experiments indicate.

4. No special disadvantage seemed to result by non-pasteurization, although we should consider it safer to pasteurize the whey cream wherever practicable.

Methods for Testing Moisture in Dairy Products.

In previous reports we have dealt very fully with methods for determining moisture in dairy work. During the past year we have been able to compare results got by using a "High-Pressure Steam Oven" with results from a "Low-Pressure" steam heated oven, which latter has been described by us in a previous report. Several other methods for determining moisture

have been brought before the public during the past year, among which may be mentioned the "Mitchell-Walker Moisture Test," fully described in Bulletin No. 167 from the Ontario Department of Agriculture. We regret we have not had an opportunity to use this test. We ordered an outfit as soon as we heard of it, but up to the time of writing it has not been delivered.

We do not think we are prejudiced in the matter, but the steam oven appeals to us because of its simplicity and reliability, and because it may be set up in any creamery, cheese factory, or other place where there is steam. There is nothing to break and it requires practically no attention. After samples have been weighed and placed in the oven, the operator may continue about his work until they are ready for the second weighing. This, too, need not be done at any specified time, after allowing sufficient time (about one hour for a high-pressure oven and four to five hours for the low-pressure) for the samples to dry. We have left samples in both high and low pressure ovens for several hours and over night at temperatures ranging from 50°F. to over 300°F., and have not noticed any ill effects on the samples.

The high-pressure oven is made of boiler plate and the parts are riveted or bolted together similar to those in a steam boiler. It will stand any pressure which a steam boiler has to undergo, and for this reason we like it better than the low-pressure oven which being made of galvanized iron tends to leak when the pressure gets too high, though we guard against this by using a safety-valve set to blow off at 8-10 lbs. pressure.

In fifteen comparative tests of butter made with the high and low pressure oven and with samples varying in weight from 2.5 to 20 grams, the average of all the results were 14.69 per cent. moisture by using the high-pressure oven at temperature of 250° to 300°F., and 14.36 per cent. by the low-pressure oven with temperatures of 212 to 219°F. The tendency was for slightly higher results (average .33%) by using the high-pressure oven. Whether this was due to more complete drying or to oxidation of some of the fat, we are unable to say, but are inclined to think it was due to the latter, as the fat always appeared darker in colour from the samples placed in the oven at the higher temperature. However, we do not think that any serious error is likely to be introduced by using the high-pressure oven, and as the results are got more quickly, as compared with the low-pressure oven, we are inclined to favour the former—in fact used it for most of our moisture work during the year.

The high-pressure oven, including combined steam guage and thermometer having a capacity of about 8 samples at once, cost us $18. If there was a demand for the ovens in large numbers we see no reason why they might not be made and sold at a cost of $8 to $10.

In four comparative tests on green cheese the results were 36.65% moisture in samples dried in the high-pressure oven and 36% for similar samples from the low-pressure oven. The tendency of results got with the cheese was similar to that got with butter, viz., slightly higher results by using a higher temperature than 100° to 105°C. for drying samples, which is a standard temperature.

MOISTURE IN CURD AND CHEESE.

This is the sixth year during which experiments have been conducted relating to the moisture content of curd and cheese and its effect upon weight and quality of cheese made.

The experiments of 1908 were conducted along five different lines. The first of these consisted of sixteen experiments made with 29,135 lbs. milk

altogether, containing an average of 3.64 per cent. fat. The milk was weighed into one vat and treated in the usual way until the whey was removed from the curd, or what is commonly known as "dipping." The average percentage of fat in the whey from all the lots was .24. At dipping, the curd was divided into two nearly equal parts in the "curd sink" or "drainer." The parts of the curd were not weighed, owing to the difficulty of weighing a curd from which the moisture (whey) was running so freely as it does at this time. One-half the curd (A) was not stirred at all, but simply allowed to drain, while the other half (B) was given the usual amount of stirring—was stirred until it was in the judgment of the cheese-maker "dry." Samples were taken for moisture determinations of the curd at dipping, and also from the green and ripened cheese.

The main points in the experiments are indicated in the following table:—

Curd.	Per cent. Acid at			Weight of Cheese		Per cent. shrinkage.	Score.
	Dipping.	Milling.	Salting.	Green Lbs.	Ripe Lbs.		Max. 100.
A. (Not stirred)	.192	.714	.974	1,318.09	1,267	3.86	92.96
B. (Stirred)	.192	.676	.936	1,363.76	1,312	3.79	92.88

The table indicates slightly more acid on the curd not stirred at the time of milling, but practically the same as the normal curd at salting time. The yield of marketable cheese was 45 lbs. more from the 29,135 lbs. milk used, or at the rate of 1½ lbs. cheese per 1,000 lbs. milk by not stirring the curd, at the time of dipping. This difference in weight might be due to differences in weight of curd at the time of dividing. (See fourth series for effect on yield of cheese.) The shrinkage was slightly greater on the cheese from the curds not stirred. The quality of the cheese was practically the same from both lots.

The difference in the percentages of moisture in the curds and cheese is shown in the next table:—

——	Curd at Dipping.	Green Cheese.	Ripe Cheese.
A (not stirred)	55.17	35.56	35.49
B (stirred)	48.19	34.90	34.45

The A curds contained about seven per cent. more moisture at the time of dipping than did the B lots which were stirred. There was not much difference in the moisture of the lots of green and ripe cheese.

The second series of experiments was made by dividing a curd into three lots—one not stirred at all, one stirred about half the usual amount and one given the usual amount of stirring. For these tests 6,881 lbs. milk, testing an average of 3.56 per cent. fat, were used. The milk was handled in one

vat up to the time of dipping, when it was divided into three equal parts as nearly as possible. The whey tested an average of .23 per cent. fat. The main points in these three experiments are shown in the table:—

Curd.	Per cent. acid at salting.	Weight of Cheese.		Per cent. Shrinkage.	Score Max. 100.
		Green.	Ripe.		
		lbs.	lbs.		
A (not stirred)	.93	217.69	209.	3.9	91.50
B (stirred one-half)	.92	214.50	206.	3.8	91.41
C (normal)	.90	222.32	215.	3.3	91.58

Here again differences in weight of cheese may be due to differences in weight of curd at the time of dividing the curds, which were not weighed. The percentage of shrinkage was least in the curds stirred to a normal condition. There was little or no difference in the quality of the cheese from the respective lots.

The percentages of moisture in curds and cheese were:—

Curd.	Curd at Dipping.	Green Cheese.	Ripe Cheese.
A (not stirred)	52.26	35.6	35.33
B (½ stirred)	50.00	35.33	35.33
C (Normal)	47.60	35.0	34.80

The third phase of the experiments on the moisture work related to the effect of leaving a larger curd without stirring. These curds were from vats of milk ranging in weight from 1,244 to 2,471 lbs., and averaged 1,590 lbs. milk for each experiment. The fat in the milk and whey averaged 3.66 and .2%, respectively. The percentages of acid at dipping, milling and salting averaged respectively, .195, .74, and .992. The percentages of moisture were 52, 35.6 and 35.6 for the lots at dipping, green cheese and ripe cheese. The weight of marketable cheese was 606 lbs. The shrinkage averaged 3.7 per cent., or about the same as in the other experiments of the series. The yield of cheese averaged 95.2 lbs. per 1,000 lbs. milk. The average score was 92.12 points out of 100. The cheese seemed to be slightly more open than our regular cheese, otherwise they were little or no different from our regular make.

The fourth series, consisting of six experiments, was made by mixing 6,170 lbs. milk, testing an average of 3.68 per cent. fat. The milk on these six different occasions, after thorough mixing and adding culture and coloring, was divided equally between two vats. They were handled as nearly alike as possible up to the time of dipping when one curd (A) was not stirred and the other (B) was given the usual amount of stirring. The average percentages of acidity and moisture are shown in the table:—

Kind of Curd.	Percentage of acid at			Percentages of moisture in		
	Dipping.	Milling.	Salting.	Curd at Dipping	Green Cheese.	Ripe Cheese.
A (not stirred)	.191	.695	.945	56.8	36.53	35.06
B (stirred)	.192	.678	.893	49.4	35.60	35.53

The average yield of cheese per 1,000 lbs. milk was 94 lbs. from the lots not stirred and 93.6 in those experiments where the usual amount of stirring was given at the time of dipping. There was little difference in the quality of the cheese. The average total scores were 92.66 and 92.9, respectively, for the lots not stirred and those stirred in the usual way.

The fifth series was conducted similar to that of the fourth, except that in the fifth the A lots (not stirred) were dipped with less acid than usual and with less than was given to the B lots. There were five experiments on this point, for which were used 4,872 lbs. milk testing 3.51 per cent. fat. The whey from the A lots tested an average of .21 and that from the B lots .215 per cent. fat.

The percentages of acid and moisture are shown in the table:—

Kind of Curd.	Percentage of acid at			Percentage of moisture in		
	Dipping.	Milling.	Salting.	Curd at Dipping	Green Cheese.	Ripe Cheese.
A (less acid and not stirred)..	.174	.694	.938	54.4	36.2	36.05
B (normal)	.19	.662	.93	48.2	35.4	34.9

The average yields of cheese per 1,000 lbs. milk were 91.9 from the lots dipped with a low percentage of acid and not stirred, while from the normal lots it was 91.5 lbs. marketable cheese. The average scores of the cheese were 92.8 for the A lots and 92.5 for the B lots.

The lots dipped sweet and not stirred contained more moisture (one per cent.), gave a greater yield of cheese (about one-half pound per 1,000 lbs. milk); and scored slightly higher in quality than did those lots treated in the usual way.

Percentages of Moisture Lost in Curd and Cheese at Different Stages of Making.

Last year we did some work to find out the percentage of moisture lost in curd and cheese at the stages of dipping, milling, salting, green and ripe cheese, where curds were not stirred and where they were stirred in the usual way. The work was continued during 1908 with the following results:

The curds not stirred lost 27.3 per cent. of the moisture contained at the time of dipping, by the time the milling stage was reached; 3.3 per cent. between milling and salting; 9.8 per cent. between salting and green cheese; 2.4 per cent. between green cheese and the marketable stage, when the cheese were two weeks to one month old.

The normal curds lost 19.6 per cent. of their moisture between dipping and milling; .8 per cent. between milling and salting; 11.1 per cent. between salting and green cheese and less than one per cent. between green cheese and marketing. (It is difficult to account for the apparent very slight loss of moisture between the cheese in the green stage and at the time of marketing, in a number of experiments, unless the moisture be unevenly distributed in the cheese causing an error in sampling.)

Conclusions.

1. Where curds out of the same vat of milk were divided into two equal parts as nearly as possible—one-half not stirred and the other stirred as usual—the curds from the lots not stirred contained about seven per cent.

more moisture at the time of dipping, but the difference in moisture of the marketable cheese was only about one per cent. There was little or no difference in the quality of the cheese.

2. In the case of dividing a curd into three lots—one not stirred, one given about half the usual amount of stirring and one part stirred in the usual way—we found very little difference in the moisture of the ripened cheese from the three lots, while the quality is practically the same throughout all the experiments.

3. Where a larger curd, in some cases from about 2,500 lbs. milk, was placed on the drainer without any stirring, the yield and quality of the cheese was quite satisfactory. Our supply of milk for cheesemaking did not allow us to make any comparative tests with similar milk in these experiments.

4. Where smaller weights of milk were made up in two vats after thorough mixing, there was an average increase of nearly one-half pound of cheese per 1,000 lbs. milk by not stirring the curd at the time of dipping. The quality of the cheese was very similar from both vats.

5. Dipping the curds comparatively sweet (about .17% acid) and not stirring them after dipping gave very satisfactory results in yield and quality of cheese.

6. The average of twenty-four experiments where curds were not stirred gave 55.062 per cent. moisture in the curds at the time of dipping. Similar experiments where the curds were stirred, averaged 48.468 per cent. moisture at dipping. The average difference was 7.594 per cent. more moisture in curds at the time of dipping as a result of not stirring.

In the green cheese the average percentages of moisture in the twenty-four lots from curds not stirred was 35.664, and from the lots stirred in the usual way the moisture content of the green cheese averaged 34.877—a difference of .727 more moisture by not stirring.

The marketable cheese from curds not stirred showed an average of 35.017 per cent., while the lots from stirred curds tested an average of 34.771 or .246 per cent. more moisture.

The result of this, and previous years' work, indicate that the curd at the time of dipping may contain from five to seven and one-half per cent. more moisture as a result of not stirring, but the cheese when sold do not seem to have more than ¼ to ½ per cent. more moisture as compared with cheese from curds stirred "dry." The advantage of not stirring lies in the saving of labor and the saving of milk solids remaining in the cheese after the moisture has evaporated.

Milk Coagulating Agents for Cheesemaking.

This is a continuation of the experiments reported on last year wherein we endeavoured to find a coagulating agent which would precipitate more of the milk solids than is done by the use of rennet, the common agent. In previous years we reported on work done with pepsin, an agent that was supposed to be superior to rennet. The manufacturers of pepsin claimed that it was really the pepsin in rennet which coagulated the milk and they argued that if this be true, why not use the pure pepsin instead of the diluted material in the form of rennet.

Last year we reported on the work done with an agent we called R A_2. We continued the work this year with this substance and also with other mixtures, but the results were not satisfactory. The percentage of solids left

in the whey with all these was slightly greater than the solids left in the whey by using rennet for coagulating the milk. The yield of cheese was also slightly less (.6 lbs. per 1000 lbs. milk) from the new agents as compared with rennet. The average quality of the cheese was slightly better in those lots made by using agents other than rennet or mixed with rennet. It looks as if we should have to depend upon rennet for coagulating milk in the process of cheesemaking, although it does seem as if we should be able to discover something which would precipitate more than half the milk solids which is about the proportion recovered at present.

Milk Solids Lost in Making Overripe Milk into Cheese.

These experiments are a continuation of the work done last year in conjunction with the Chemical department: We did not give the results of last year's work because they were so different from what is the commonly accepted belief regarding the effects of handling milk which is overripe for cheesemaking. As we got similar results during the past season we may give these and they will serve to indicate the general trend of the experiments conducted during the past two years. We pointed out last year the difficulties in the way of making a satisfactory test of the problems involved. If we took normal milk one day and compared results with "fast" milk the next, or the previous day, many other factors might enter into the problem. This, however, is the manner in which the average cheesemaker would arrive at his conclusions, and it is the plan followed by us in most of the experiments. A few tests were made by dividing a vat of milk into two lots and allowing one-half to become overripe in the vat, while the other half was handled as a normal curd. This is the more accurate method, but the "practical" man objects, saying, "this is not the way the milk becomes sour in ordinary factory work, and you ought, so far as possible, to have the conditions similar to those found at the factory." As previously noted we tried both plans, but the results were not very satisfactory in either case, i.e., the loss of milk solids in the whey was about the same from both normal and fast-working milk.

During the past year five experiments were made comparing overripe milk as delivered by patrons, with normal milk delivered by the same patrons on succeeding days. The curds from the lots of overripe milk remained in the whey an average of 53 minutes. The yield of ripe cheese per 1,000 lbs. milk was 91.3 lbs. The average score of these cheese was 93.3. The total solids in the milk averaged 12.16. The solids in the whey averaged 6.8 per cent.

The curd from the normal lots were in the whey an average of 2 hours and 55 minutes. The yield of cheese per 1,000 lbs. milk was 94 lbs. The average score of the cheese was 95. The milk averaged 12.24 per cent. solids, while the whey contained 6.71 per cent. solids—or an average of but .09 per cent. less than did the whey from the overripe milk.

Two tests were made for the moisture in the curds at the time of dipping, and in the green and ripe cheese. There was very little difference at these stages—in the ripe cheese the percentages of moisture was the same for both lots, viz., 34.6. Similar results were got in the case of an experiment made, wherein a lot of milk was divided into two equal parts. One-half was normal and the other was allowed to become overripe. The solids in the milk were 11.889 per cent. The solids in the whey from the normal lot was 6.67 per cent., and in the whey from the overripe milk it was 6.66 per cent. The normal curd remained in the whey for 2½ hours, while the overripe

curd dipped in 50 minutes. The whey from the normal lot tested .23% fat and the other .25%. The yield and quality of the cheese were the same from both lots.

All the curds from the fast working milk were cut with a fine wire perpendicular curd knife and the normal curds with the regular 3-8 inch blade knives.

Fine vs. Coarse Wire Curd Knives.

Last year we pointed out the tendency towards the use of wire perpendicular curd knives instead of the steel blades so long in use. We also said that the tendency was to have the wires about 3-8 inch apart, instead of ½ to 5-8 inch, as in the case of the ordinary blade knives. We mentioned that as a result of the experiments conducted with "fast-working" milk, a "knife made of fine wire and having the wires ¼ inch apart is evidently an improvement over the regular form of curd knife. The advantages are, less loss of fat in the whey and an increased yield of cheese, amounting in these experiments to nearly one pound of cured cheese per 1,000 lbs. milk."

Experiments were also reported on last year comparing the ⅜ inch wire curd knife with a blade knife of similar size for cutting curds from normal milk. There was a slightly greater loss of fat in the whey from the curds cut with the wire knife, but this was probably due to the wires being too coarse.

During the past season experiments were made with curds from normal milk comparing a perpendicular curd knife made of fine wire and having the wires ¼ inch apart, with a coarser wire knife having the wires ⅜ inch apart.

Fifteen experiments were made. Altogether there were 12,822 lbs. milk used, testing an average of 3.71 per cent. fat. The whey from the lots cut with the fine knife tested an average of .23 per cent. fat. From the lots cut with the coarser wire knife, the average percentage of fat in the whey was .26. Each lot of milk was divided into two equal parts and placed in separate vats. All other points, except the cutting of the curd, were alike so far as possible. Both vats were cut once with the horizontal ⅜ inch blade knife, then each was cut twice with the respective wire knives. The total yield of green cheese from the lots cut with the fine wire knife was 640.23, and from the lots cut with the coarser knife, 644.63. The ripened cheese weighed respectively 611 and 614 lbs. The percentage of shrinkage was 4.5 in the lots cut with the fine knife and 4.7 in the coarse wire lots. The yield of ripened cheese per 1,000 lbs. milk was 95.3 and 95.7 lbs. respectively from the fine and coarse wire knives. The average score of the lots of cheese was 93.6 and 93.9—being slightly higher for the cheese made by using the coarser knife.

It is difficult to account for the increased yield of cheese by using the coarse knife, except that the latter cheese may have contained more moisture. Only two lots of such were tested for moisture. The average results were:

Percentage of Moisture in Curd and Cheese.

—	Dipping.	Green Cheese.	Ripened Cheese.
¼ inch knife	49.5	35.	34.
⅜ inch knife	48.5	35.2	34.3

These two tests indicate about one per cent. more moisture in the curds at the time of dipping when the fine knife was used, but the green and ripened cheese from these lots had slightly less moisture. Assuming that the average of these two tests represents the average difference in moisture of all the experiments, it would not account for all the difference in yield of green and ripened cheese. In the green cheese from the lots cut with the coarser knife the difference in moisture would account for about 1¼ lbs., whereas the actual difference was nearly 4½ lbs. In the ripened cheese, the increased moisture in these lots which were tested would account for less than two pounds, whereas the actual difference in yield was 3 pounds in favor of the coarser knife.

These experiments will need to be repeated before drawing definite conclusions.

Methods of Pressing Curds.

The common method of pressing curds is to tighten the press gradually during about the first three-quarters of an hour after putting the curd in the hoops, and again during the first two or three hours, after what is known as "dressing" the cheese. Full pressure is then applied to the cheese. The object of the experiments made in this connection was to see whether light pressure continued during two days would give better results; and also to see whether or not any ill effects resulted from applying full pressure at once to the curd after placing it in the hoops and to the cheese after dressing. Only one experiment was made by testing the effects of long, light pressure as we did not get a second press until late in the season. As we were using our regular press every day; it was necessary to have another press for these experiments. Altogether seven experiments were made comparing normal methods of pressing with applying full pressure on the cheese at once. The cheese were left in the press about three-quarters of an hour before "dressing" and for twenty hours after "dressing." They were turned in the hoops the morning after making the cheese.

Normal vs. Gradual Light Pressure.

On August 6th, 492 lbs. milk testing 3.6 per cent. fat, the whey from which tested .2 per cent. fat, was made into curd, which was divided into two equal parts at the time of putting the curd into the hoops. The A cheese was pressed in the usual way. The B cheese was pressed very lightly and gradually until August 8th, or for forty-eight hours. The weights of green cheese were 23¼ and 23½ lbs. respectively. The weights of commercial cheese were 21 and 22 lbs.—or an increase of one pound of cheese from the curd pressed lightly for about double the usual length of time. Both curds scored exactly the same in all points.

The percentage of moisture in the curd at dipping, in green and ripe cheese were as follows:

	Curd.	Green Cheese.	Ripe Cheese.
A	48	35.2	34.6
B	48	34.8	33.8

Too much stress cannot be laid upon the results of one experiment, but the results indicate that light, gradual pressing produces more cheese, and that both the green and ripe cheese contain slightly less moisture as compared with normal pressing.

NORMAL VS. HEAVY PRESSURE APPLIED AT ONCE TO CURD AND CHEESE.

For these seven experiments there were used 4,000 lbs. milk averaging 3.83 per cent. fat. The average percentage of fat in the whey was .18. Each lot of milk was handled as one curd up to the time of putting to press. The A lots were pressed in the usual way, while the B lots had full pressure applied at once before and after "dressing." The moisture in curd, and cheese was determined in but one lot on August 11th. The curd at dipping contained 49.8 per cent. The green cheese contained 34.8 and 34.6 per cent., for the A and B lots. The ripe cheese contained 34.4 and 34.2 per cent. moisture, respectively. The A lots shrank 5.4 per cent. during the ripening period; while the B lots shrank 5.6 per cent. The average score of the cheese was:

	Flavor.	Closeness.	Even Color.	Texture.	Total.
	Max. 40	Max. 15	Max. 15	Max. 20	Max. 100
A......	37	13.87	14	18.43	93.32
B......	37.2	13.81	14	18.62	93.56

There did not appear to be much difference in yield or quality of cheese from the two methods of pressing. Further experiments are needed before drawing conclusions.

PRESERVATIVE IN CHEESE.

Two experiments were made to note the effect, if any, of adding one quarter per cent. of borax to curds at the time of adding the salt. The borax was mixed with the salt and both were applied at the same time. One lot of cheese was kept for two months (one week in the ordinary ripening room and the remainder of the time in cold storage) and were scored twice during that time. The other lot was scored once at the usual time—about one month after making. Mr. Frank Herns, Chief Instructor for Western Ontario, scored these lots the first time on May 6th. They were scored the second time on June 13th, by all the Western Instructors who met at the Dairy department of the College on that date. The following table shows the details of the scoring:

Kind of Cheese.	Date of Scoring.	Flavor.	Closeness.	Even Color.	Texture.	Total.
		(40)	(15)	(15)	(20)	(100)
Normal........	May 6......	37	14	14	16.5	91.5
"	June 13.....	36	14.25	14	16.5	90.75
Preservative....	May 6......	37	14	14	17	92.
"	June 13.....	35	14.25	14	16.75	90.
Normal......	Av. all scores both lots	36.3	14.08	14.16	16.8	91.4
Preservative..		36.	14.08	14.16	17.08	91.3

It will be noticed that the normal lot lost one point in flavor from May 6th to June 13th, while the lot with preservative in it lost two points in flavor. When we average all the scores given the cheese in both experiments we find very little difference in general quality, and conclude that under these conditions preservatives have little or no effect upon cheese.

EXPERIMENTS IN BUTTERMAKING.

Effects of Temperature of Wash Water on Moisture Content, Yield, and Quality of Butter.

These experiments are a continuation of the work done during three previous years. Six trials were made comparing the effects of washing butter with water at a temperature of 50 degrees F., and washing butter from similar lots of cream with water at a temperature of 58 degrees F. These tests were all made during the month of April and May. The average sized churning was 307.5 lbs. cream, testing 23.7 per cent. fat. The average churning temperature was 54.5 degrees F., and the time required for churning was about 33 minutes. The total pounds of butter made from the lots washed with water at 50 degrees F., was 515.5. The butter from the lots washed with water at 58 degrees F., weighed 517.5 lbs.—a gain of two lbs. butter on a total of 1,845 lbs. of cream containing 435.5 lbs. fat. The overrun from the lots washed with water at 50 degrees averaged 18.3 per cent. The lots washed with water at 58 degrees gave an overrun of 18.8 per cent.—half a per cent. more than did the previous lots. The relative percentages of moisture in the butters were, [illegible].65 and 13.83—a difference of one-half per cent. more in the lots washed with water at the higher temperature.

Quality of the Butter.

The average quality of the lots of butter was very similar as shown in the table:

Kind of Butter.		Flavor.	Grain.	Color.	Salt.	Package.	Total.
		(50)	(20)	(15)	(10)	(5)	(100)
Washed at 50°F.	1st score..	43.9	19.1	14	10	5	92.0
	2nd "	40.	19.5	13.8	10	5	88.3
Washed at 58°F.	*1st score..*	*43.95*	*18.95*	*13.4*	*10*	*5*	*91.30*
	2nd "	39.9	19.37	13.7	10	5	87.97

Influence of Size of Churning on Moisture Content of Butter.

This is a continuation of the work done last year. Eight experiments were made with small churnings which averaged 225 lbs. cream each, testing 25.3 per cent. fat. The seven larger churnings averaged 358.8 lbs. cream each. All churnings were made in a small-sized Simplex churn. The average churning temperature was about 55 degrees F. The average time required to churn the small lots was 22 minutes; and that of the larger lots 31.7 minutes. The buttermilk tested .19 per cent. fat for both. The per cent. overrun was 19.37 for the small churnings and 19.33 for the larger. The percentage of moisture in the butter from the two lots was 13.91 and 13.88 for the small and larger churnings.

The scoring of the butter were as follows:

Kind of Butter.		Flavor.	Grain.	Color.	Salt.	Package.	Total.
		(50)	(20)	(15)	(10)	(5)	(100)
Small Churnings.	1st score.	44.8	19.68	13.8	10	5	93.28
	2nd "	42.3	19.18	13.6	10	5	90.08
Larger "	1st "	44.8	19.5	13.8	9.9	5	93.0
	2nd "	42.4	19.3	13.7	10	5	90.4

These scorings indicate little or no difference in the quality of the butter when fresh, or after being kept for a month or more in the refrigerator.

EXPERIMENTS TO ASCERTAIN IF UNIFORM MOISTURE CONTENT OF BUTTER IS PRACTICABLE BY FOLLOWING ONE METHOD.

This also is a continuation of the work done last year to find out how close to a uniform percentage of moisture may be got in butter by following a uniform plan or method. Last year the range of moisture in the different lots of butter was from 13 to 15 per cent. where one plan was followed as closely as possible on several different churnings. We were able to make but four trials this year. The results were that a much more uniform moisture content in the butter was obtained than was got last year. The average pounds of cream in each churning was 286, testing 23 per cent. fat. The churning temperature was 55 degrees F.: time required for churning 28 minutes; the temperature of the wash water averaged 60 degrees F. The butter was given an average of 13 revolutions of the worker in the Simplex. The pounds of butter averaged practically 78, per churning. The percentage of overrun for individual churnings ranged from 17.5 to 21.25. The percentage of moisture in the butter from the individual churnings ranged from 13.5 to 14.15 and averaged 13.85 for the four trials.

The quality of the butter was quite uniform for all the lots, hence it is not necessary to give the detailed scorings for the different churnings.

Conclusions.

1. The lots of butter washed with water at a temperature of 58 degrees gave an increased overrun of about one-half per cent., as compared with lots washed with water at 50 degrees F., in the months of April and May. This extra overrun appears to have been practically all extra moisture in the butter, as the tests for moisture indicated about one-half per cent. more water in the lots washed in water at the higher temperature. There was little or no difference in the quality of the butter, either when fresh or when held for a month or more.

2. Under the conditions given, the size of the churning did not appear to influence the moisture or quality of the butter made.

3. The results this year of a uniform method of churning and working butter showed more uniform results in the moisture content of the butter as compared with last year, but the overrun varied nearly four per cent. in individual churnings. As stated in previous years we have not found a constant relation between overrun and moisture content of the butter.

PASTEURIZATION OF SOUR CREAM, WITH AND WITHOUT CULTURE (STARTER) ADDED AFTER HEATING AND COOLING.

We were able to make but one experiment on this interesting phase of creamery work. We hope to be able to continue this work next year as it is a live question among creamerymen. Will it pay to pasteurize sour cream? is a question asked very frequently. A number of creameries adopted the plan and then discontinued it, thinking it did not pay. Some buttermakers are of the opinion that it causes too great a loss of fat in the buttermilk, while others, because of the lack of proper cooling facilities, thought it made too much labor for any improvement there might be in the quality of the butter.

On May 27th, 732 lbs. sour cream was divided into three lots of 244 lbs. each, testing 26.5 per cent. fat. The first lot was held over night and churned the next day without pasteurizing. This amount of cream made 77 lbs. butter. The overrun was 19.08 per cent. The buttermilk tested .23 per cent. fat.

The second lot of cream was pasteurized in the afternoon at a temperature of about 180 degrees F.: ten per cent. of culture was added and the next day it was churned at a temperature of 55 degrees F. The buttermilk tested .24 per cent. fat. The yield of butter was 75.75 lbs.—an overrun of 17.15 per cent., or about two per cent. less than from the lot unpasteurized.

The third lot was also pasteurized and held over night, but no culture was added to the cream. The buttermilk tested .45 per cent. fat, but the yield of butter was the same (75¾ lbs.) as for the lot pasteurized and having culture added.

The quality of the butter from the three lots of cream is shown in the table. The first scoring was made on June 13th, and the second, October 15th, or nearly five months after the butter was made.

The average temperature at which samples of the butter was kept in print form would be about 45 degrees F., in an ice cold-storage.

Kind of Butter.	Flavor.	Grain.	Color.	Salt.	Package.	Total.
	(50)	(20)	(15)	(10)	(5)	(100)
Unpasteurized 1st score..........	40	17.5	12.5	10	5	85
2nd "	30	20	14	10	5	79
Average..................	35	18.75	13.25	10	5	82
Past. & 10 p.c. culture 1st score..	41.5	18	13	10	5	87.5
2nd " ..	32	20	14	10	5	81
Average..................	36.75	19	13.5	10	5	84.25
Past. and no culture 1st score....	41.5	18	13	10	5	87.5
2nd "	35	20	14	10	5	84
Average..................	38.75	19	13.5	10	5	85.75

Conclusions.

It is not wise to draw conclusions from one experiment, but the results indicate a greater yield of butter from the raw cream. The quality of the butter made from the raw cream was not so good when first made, neither did it keep so well as that made from the lots pasteurized. The lot without culture seemed to hold its flavour better than did that with culture added to the cream after pasteurizing.

Borax vs. Commercial Preservative.

One of the creamery instructors is of the opinion that borax, which had been recommended by us as a preservative to be used in butter, had a tendency to make the butter more "greasy" in texture as compared with the commercial forms of preservatives. A lot of cream (400 lbs.) was divided on May 9th, into two equal parts and churned. The cream tested 24 per cent. fat and was treated in the usual way up to the time of salting. On the

butter from the one lot of cream was sifted 4 ounces of powdered borax On the butter from the other lot was sifted 4 ounces of commercial preservative. Both lots were then worked in the usual way and samples kept for scoring purposes. The lots were scored on June 13th and again October 15th, having been kept in an ice cold storage at about 45 degrees F., in the meantime. The average of both scorings in grain was 19.25 for the borax lot and 19. for the commercial preservative lot. The average total scores were 89.25 and 90.25 for the borax and commercial preservative lots respectively.

Conclusion.

The butter in this experiment did not show any marked differences in grain or general quality from the use of the two kinds of preservatives. In previous years we have not seen any marked difference in the grain of butter by using the various kinds of butter preservatives on the market. All saltless butter appears more or less "greasy" in texture and "dead" in color.

Respectfully submitted,

H. H. DEAN.

PART X.

THE PROFESSOR OF BACTERIOLOGY.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to submit the following report upon the work of this department for the year ending November 30, 1908.

INSTRUCTION. Lecture and laboratory courses were conducted for College, Macdonald, and Short-course students, as required by the College calendar. The courses for the senior and sophomore classes were made to consist of laboratory work instead of lectures only, as has been the custom in previous years. It was found, however, that in the present insufficient laboratory accommodation, laboratory work for these two classes could not be conducted successfully, and the project was abandoned at the beginning of the present school year. Two special lectures on canning of fruits and vegetables were given to Domestic Science classes of Macdonald Institute. Six periods of laboratory demonstrations were held for students attending the summer school. Two half-day periods were spent with the Ontario Dairy Instructors on various problems of the creamery and cheese factory.

At the present time, two members of the senior year are taking the Bacteriology option, and special instruction has been given to two other students during the year.

MEETINGS ATTENDED. I attended the annual meeting of the Society of American Bacteriologists, at Chicago, last December, and the International Congress on Tuberculosis held in Washington in October.

PUBLICATIONS. The results of our work during 1906 and 1907 on the preparation and distribution of nitrogen-gathering bacteria for inoculating seeds of legumes were published in March as Bulletin 164. One press bulletin was issued, papers contributed for the College Nature Study bulletin, and the annual report of the Farmers' Institute, and to agricultural papers. A paper on "Tuberculosis Among Farm Animals" was given before the special students in the live stock and seed courses last winter. At the request of Dr. C. E. Marshall, of Michigan Agricultural College, I have made two contributions to a series of papers on laboratory technique being edited and published from the Bacteriological Laboratory of that college.

ROUTINE LABORATORY WORK AND ANALYSES. During the year we prepared and sent eighty-six lactic starters for creameries and cheese factories.

The widely diversified nature of the laboratory work may be noted from the following summary of analysis and examinations of specimens submitted by farmers and others during the year:

SPECIMENS EXAMINED, 1908.

Anthrax	1	Egg	1
Blood	1	Milk	26
Calf	1	Mutton	1
Canary	1	Pigs	3
Cheese	4	Plant diseases	9
Diseased hens	35	Pus	1
" chicks	5	Sputum	10
" duck	1	Tumor	1
" wild gander	1	Water	10
" " goose	1		
" turkey	1	Total	118
" organs	4		

Legume Bacteria.

The distribution of cultures of legume bacteria was continued, two thousand one hundred and thirteen cultures being sent to nine provinces of the Dominion and to five other countries. Six hundred and thirty-four reports from farmers were received and the summary of results appears in the following table. The plus columns indicate the reports in which positive benefit resulted from inoculation of the seed, and the minus columns show those in which no benefit was apparent.

Results of Seed Inoculation, 1908.

	Alfalfa		*Red Clover*		*Alsike Clover*		*Peas*		*Beans*		*Sweet Peas*	
	+	—	+	—	+	—	+	—	+	—	+	—
Ontario	261	140	43	42	9	5	9	16	4	4	2	1
Percentage	65	35	50.5	49.5								
British Columbia	11	3	5	1							1	
Percentage	78.5	21.5	83.3	16.7								
Alberta	10	8	1				2					
Percentage	55.5	44.5	100									
Quebec	10	6									1	
Percentage	62.5	37.5										
P. E. Island	4	1	1									
Percentage	80	20	100									
Saskatchewan	3	1					1					
Percentage	75	25										
Nova Scotia	4	3	2	1	1		1	1			1	
Percentage	57	43	66.7	33.3								
New Brunswick	3	1	1									
Percentage	75	25	100									
Manitoba	3	2	2									
Percentage	60	40	100									
United States				1			1					
Percentage				100								
Total	309	165	55	45	10	5	14	17	4	4	5	1
Percentage	65	35	55	45	66.7	33.3	45	55	50	50	83.3	16.7

Cultures for inoculating seed will be sent during the coming season for seed of the following crops:—Alfalfa, red clover, alsike clover, peas, beans, sweet peas, vetches. The laboratory prepares but one size package of culture, that being sufficient for 60 pounds of seed, and a nominal price of twenty-five cents is charged for each package to cover cost of preparation, postage, etc. Each kind of seed requires a different kind of culture. All applications should state the kind of seed on which the culture is to be used, the number of cultures desired, and as near as can be judged the date of seeding. Remittance may be in any convenient way and should be sent with applications to S. F. Edwards, O.A.C., Guelph, Canada.

RESEARCH. Most of our available time for research has been spent in further studies of the nitrogen-accumulating bacteria of the legumes. The results of these studies are now nearly ready for publication.

Mr. Barlow conducted some investigation on cucumber wilt, besides co-operating in the studies above mentioned.

Considerable time was spent during the year in further studies of the disease of incubator chicks known as "white diarrhoea". Observations on this disease are still being made.

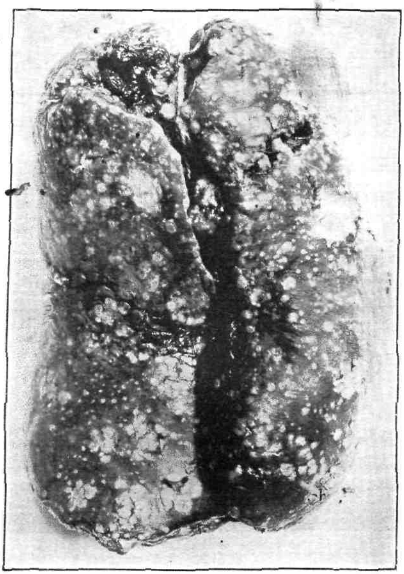


Fig. 1. Liver of hen that died of tuberculosis. Nearly natural size.

During the summer Mr. B. Barlow resigned his position as lecturer n Bacteriology on account of ill health, and his place was taken by Mr.). H. Jones, one of last year's graduates of this College, who is already roving a valuable member of the laboratory staff.

TUBERCULOSIS OF FOWLS.

One phase of our laboratory work which deserves the attention of)ntario farmers is the comparatively large number of cases examined of uberculosis of the common barnyard fowls. During the past year, we ave had sent to this laboratory from various parts of the Province, nineeen fowls affected with tuberculosis. This in itself is not a large number, ut it is an increase of fifty-three per cent. over any previous year, and is

one more than the total number sent in during the previous four years. Prof. Graham, of the Poultry Department, states that he receives an average of a letter a week from farmers describing disease in their flocks, the symptoms of which point unmistakably to tuberculosis. We receive a number of similar letters.

These facts indicate that this disease is widely prevalent in Ontario, and the farmer or poultry raiser should familiarize himself with the disease so that when he finds it in his own flock he will be able to cope with it intelligently and effectively.

Tuberculosis may exist extensively among fowls, especially in large flocks, but seldom kills enough birds at any one time to draw particular attention of the owner to the trouble. Many farmers say they have been losing a bird or two occasionally for a year or more, and that the loss is gradually increasing. The loss constitutes a steady drain, yet is not large enough at any one time to awaken the farmer to a realization of what the total loss would amount to in a series of years. Nor is the loss always a gradual one.

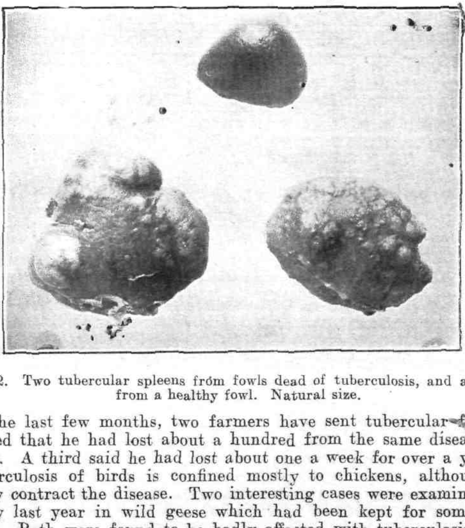


Fig. 2. Two tubercular spleens from fowls dead of tuberculosis, and a spleen from a healthy fowl. Natural size.

Within the last few months, two farmers have sent tubercular fowls, and each stated that he had lost about a hundred from the same disease within two years. A third said he had lost about one a week for over a year.

Tuberculosis of birds is confined mostly to chickens, although other fowls may contract the disease. Two interesting cases were examined in our laboratory last year in wild geese which had been kept for some time in captivity. Both were found to be badly affected with tuberculosis, and we transmitted the disease from these cases to chickens. Pheasants, turkeys, and pigeons may be affected. Authorities differ in their opinion as to the susceptibility of ducks. Singing birds in captivity are said to be highly susceptible.

Symptoms. There is no noticeable symptom of tubercular infection until the disease has progressed far enough to cause emaciation, which is nearly always present and which in advanced cases is extreme. Pernot, of the Oregon Experiment Station, described a case in which a Plymouth

Rock hen originally weighing four pounds was reduced in weight to twenty-two ounces. The comb and wattles and skin about the head usually become pale. Emaciation is usually accompanied by lameness, and there is nearly always a persistent diarrhoea, the feces appearing yellowish or greenish white. In the latter stages of the disease the feathers become ruffled, and the fowls are weak, more or less mopy and move about but little. The eyes are bright in most cases until death is near. The appetite is good throughout the sickness, and the fowls usually eat ravenously until a few days before death.

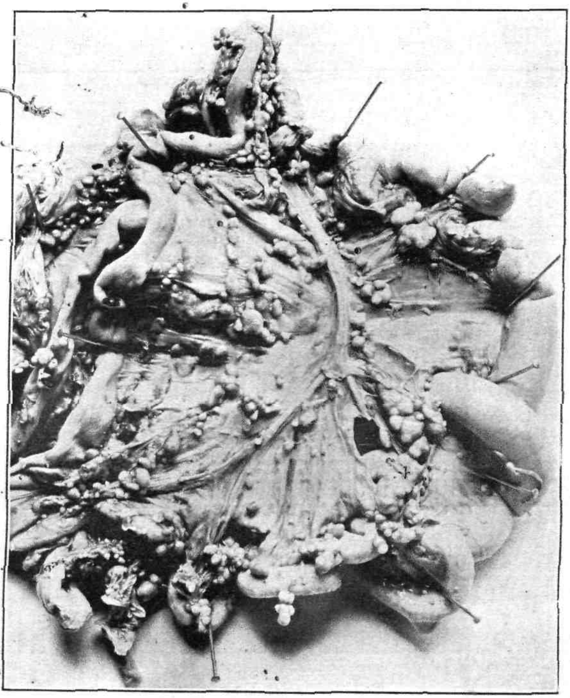


Fig. 3. Tuberculous mesentery of a fowl. (From Moore, "The Pathology of Infectious Diseases of Animals".) By permission.

POST-MORTEM APPEARANCE. The lesions are widely distributed and vary much in their location in different individuals. The liver is almost invariably affected. It is usually enlarged and studded more or less abundantly with yellowish-white nodules of a somewhat cheesy consistency, vary-

ing in size from a pin head or even smaller to one-quarter inch or more in diameter. (See fig. 1.) The nodules protrude more or less, and may be readily separated from the surrounding liver tissue. The lesions vary in this respect from those of blackhead, in which disease the lesions are sunken below the surrounding tissue, are more yellow in color, and may be much larger. We have in some cases found mixed infection with tuberculosis and blackhead in the same organ. The spleen, in health; a small, rounded, purple organ about half an inch in diameter, is frequently affected, and in consequence is greatly enlarged, sometimes to three or four times the original size, and contains nodules of the same character as those in the liver. (See fig. 2.) The intestines may be affected, in which case rounded masses of varying size will be found in the intestinal walls.

The mesentery, the thin membrane to the border of which the intestine is attached, is occasionally dotted with nodular masses. (See fig. 3.) The kidneys, lungs, spleen, ovaries, skin, and bones may be affected.

The table which follows shows the distribution of lesions in thirty-seven cases examined in this laboratory during the last five years, with date of examination. The X's indicate the extent of the infection. XXX indicates extensive infection with many nodules. XX indicates less extensive progress of the disease, and X indicates that only a few nodules were present.

Fowl No.	Died or Killed	Organs affected.								
		Liver.	Spleen	Intestine.	Mesentery	Lungs	Skin.	Muscles.	Pancreas.	Stomach.
1........Aug. 1903......	K	xxx	xxx	xxx	—	—	—	—	—	—
2........Dec. 1903......	K	xx	xxx	—	xx	—	—	x	—	—
3, 4......Sept. 1904.....	K	xxx	xxx	—	—	—	—	—	—	—
5........Jan. 1905......	K	xxx	xxx	—	—	—	—	—	—	
6........Feb. 1905......	K	x	x	......	......	......	......	......	......	......
7........Feb. 1905......	D	xxx	xx	—	—	—	—	—	—	—
8........Feb. 1906......	K	xxx	xxx	—	—	—	—	—	—	—
9, 10, 11..June, 1906.....	K	xxx	xxx	xx	x	—	—	—	—	—
12........July, 1906.....	K	xxx	xxx	xx	—	—	—	—	—	—
13........Dec. 1906......	D	xxx	xxx	xxx	—	—	—	—	—	—
14........Dec. 1906......	K	xxx	xxx	xxx	—	—	—	—	—	—
15........March, 1907....	D	xxx	xx	xx	—	—	—	—	—	—
16........Aug. 1907......	K	xx	xx	—	—	—	—	—	—	—
17........Aug. 1907......	K	xx	—	xx	—	—	—	—	—	—
18........Dec. 1907......	D	xxx	—	—	x	xx	x	—	—	—
19........Dec. 1907......	K	xxx	—	—	x	xx	—	—	—	—
20........Feb. 1908......	K	xxx	xx	—	—	—	—	—	—	—
21........March, 1908....	K	xx	xx	x	—	—	—	—	—	—
22........March, 1908....	D	xxx	xx	xx	—	—	—	—	—	—
23........March, 1908....	K	xxx	xxx	xxx	—	—	—	—	—	—
24........March, 1908....	K	xxx	xxx	xxx	—	x	—	—	—	—
25........April, 1908.....	D	xxx	xxx	xxx	xxx	—	—	—	xxx	—
26........July, 1908......	D	xx	—	—	—	—	—	—	—	—
27........July, 1908......	K	xx	xxx	xxx	—	—	—	—	—	xx
28........Sept. 1908......	K	xxx	xxx	xxx	—	—	—	—	—	—
29........Sept. 1908......	K	xxx	xxx	xxx	—	—	—	—	—	—
30........Sept. 1908......	K	xxx	xxx	xxx	—	—	—	—	—	—
31........Sept. 1908......	D	xxx	xxx	xxx	xx	xx	—	—	—	—
32........Sept. 1908......	K	xxx	xxx	xxx	xx	xx	—	—	—	—
33........Oct. 1908......	*	xxx	—	—	—	—	—	—	—	—
34........Oct. 1908......	D	xx	xx	—	—	—	—	—	—	—
35........Oct. 1908......	D	xx	xx	—	—	—	—	—	—	—
36........Nov. 1908......	K	xxx	[illegible]	xx	—	—	—	—	—	—
37........Dec. 1908......	**	xx	x	—	—	—	—	—	—	—

* Liver only sent for examination.
** Turkey. Viscera only sent for examination.

SPREAD OF TUBERCULOSIS. Tuberculosis is caused by a minute bacterial organism, Bacterium tuberculosis of birds. (See fig. 4.) The bacteria gain entrance to certain portions of the body and multiply there, causing the formation of the nodules or tubercles seen on autopsy. The spread of the disease occurs when the bacteria are transferred directly or indirectly from the affected birds to the healthy ones.

If an examination is made of the tubercles occurring on the walls of the intestine, they will be found in many cases to have a cavity in the centre which communicates with the interior of the intestine. A microscopical examination of the intestinal contents at such points shows that enormous numbers of tubercle bacteria are present. The conclusion that the bacteria are liberated with the droppings is unavoidable. We have made microscopic examinations of the droppings in a number of cases and found the tubercle bacteria present. The droppings of tubercular fowls must, therefore, be regarded as one of the most important sources of infection of the

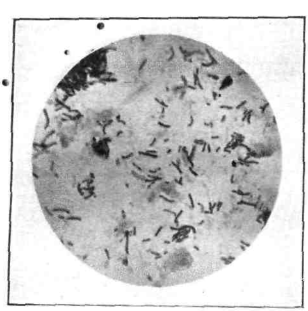


Fig. 4. Bacterium of tuberculosis from the lung tissue of a fowl. X 1,000.

healthy stock. The common farm practice of feeding from the ground or in low dishes or troughs, furnishes ample opportunity for the food to become fouled with feces, and one or two sick birds passing tubercle bacteria might easily serve to infect a large percentage of a flock. Although sunlight is rapidly fatal to this germ, it does not have opportunity to act freely on all infectious material. Indoors the bacteria may remain alive and dangerous for many weeks, and may infect the healthy birds. There is always the possibility also of carrying infected feces on the feet to food outside of the chicken house. Another dangerous practice, all too frequent, is that of leaving carcasses of birds that have died of tuberculosis to be eaten by the hogs or chickens.

THE CONTROL OF TUBERCULOSIS IN FOWLS.

There is no cure for tuberculosis in fowls, and attempted treatment is a waste of time and money expended for so-called remedies. The only course open is to adopt measures for eradicating the disease from flocks already infected, and for preventing future infection.

ERADICATION. The quickest and most effective method of eradicating the disease is to destroy all the fowls, and thoroughly disinfect the premises. In small flocks known to be infected with tuberculosis, this measure is advisable. The fowls could be examined and all that were found healthy could

be sold, thus lessening the loss considerably. In larger flocks, or when it is desired to preserve a certain strain in breeding, less drastic measures may be adopted with final satisfactory results. There is no known test to determine the presence of the disease until it has progressed so far as to cause lameness or emaciation. Ward, of California, has shown that tuberculin is of no value as a diagnostic agent for tuberculosis of fowls. There is good reason to believe that birds may be discharging the germs in the droppings, although the disease may not be far enough advanced to show noticeable symptoms. Hence all individuals of the flock must be regarded as dangerous to those free from disease, and the latter should be kept separate. All fowls suspected of having the disease should be slaughtered and the carcasses completely burned. Roosts, houses, etc., should be disinfected frequently. Inasmuch as affected birds may be continually distributing the bacteria in their feces, an occasional disinfection will be insufficient. No feed should be given the fowls on the ground. Feeding dishes or troughs should be frequently scalded with boiling water. It is not believed that this disease is transmitted through the egg. Hence if the young chicks are placed on ground not previously inhabited by the old stock, the chances are very favourable for rearing them free from tuberculosis. Care should be observed in purchasing new birds that they come from flocks which are free from disease. Experience on some of the large poultry ranches of California has shown that the transfer of laying hens is an important factor in the transmission of the disease. Poultry raisers should, as far as possible, raise their own stock.

DISINFECTION. The first thing to do in putting the poultry premises in sanitary condition is to scrape the roosts, walls, floors, and nests thoroughly clean. This loose rubbish, together with loose boards, etc., should be completely burned. When this has been don , the entire place should be whitewashed, with lime water—crude carbolic acid—solution, in the proportion of twenty gallons of lime water to one gallon of crude carbolic acid. Unslaked lime should be used mixed with enough water to give it the consistency of thin cream, and the carbolic acid then added. This mixture may be sprayed on or put on with a brush, due care being observed to see that every particle of surface in the poultry house is well covered. Coal tar disinfectants may be used alone in place of the above mixture, but they are more expensive and no more effective. After disinfection, clean boards may be placed beneath the roosts to catch the droppings, thus facilitating the work in future cleaning. Slaked lime placed on these boards will absorb the moisture from the droppings and will add to their fertilizing value.

There is no way of effectually disinfecting soil. The yards, however, should be kept as clean as possible and free from loose boards, and all unnecessary litter of any kind.

If there are occasional losses of fowls on the farm, and the cause is unknown, the birds should be examined after death for evidence of tuberculosis, as shown in the accompanying illustrations. If desired, specimens may be sent direct to this laboratory for examination. Such material should be securely packed and sent by prepaid express so as to reach its destination as soon as possible after the death of the bird. The specimens will be examined and reported upon without further cost to the sender.

Respectfully submitted,

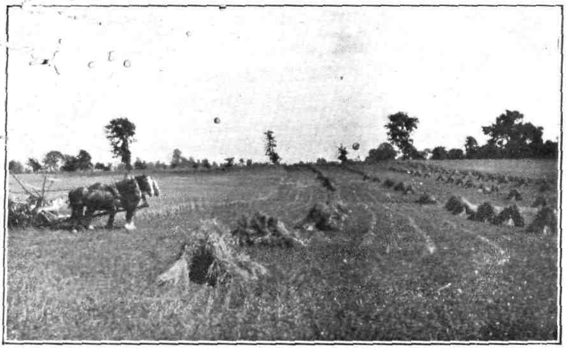
S. F. EDWARDS.

PART XI.

THE PROFESSOR OF ANIMAL HUSBANDRY AND FARM SUPERINTENDENT.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to submit herewith the report of my department, which will touch but briefly upon the principal items of general interest to the public.



In a College oat field.

FARM CROPS.

The past season gave us very fair crops on the whole, though the dry weather of the latter part of the season caused some damage. The hay crop was fair, averaging about two tons per acre. Winter wheat produced a very heavy crop of straw, and the yield and sample were somewhat injured by lodging. The average yield will be fully forty bushels per acre. Oats are a good sample, and the yield will be in the neighborhood of fifty bushels per acre. The barley was seeded with alfalfa, and was sown at the rate of only one bushel per acre. As a result, the crop was somewhat light, and the sample not up to that of past years. As we have not finished threshing any of these crops, we cannot state the yield definitely. Mangels were a good crop, yielding nine hundred bushels per acre. Potatoes are free from rot and scab, and yielded slightly over two hundred bushels per acre. Corn was about up to the average with a yield approximating fifteen tons per acre. Turnips were practically a failure, being destroyed by the plant louse and some form of blight.

THE DAIRY HERD.

The dairy herd has been strengthened at several points during the year, and we now have reasonably good representatives of the Ayrshire, Holstein, and Jersey breeds.

Following is the record of the herd for the past year:

RECORD OF DAIRY HERD FROM DECEMBER 1ST, 1907, TO NOVEMBER 30TH, 1908.

Name.	Breed.	Age, Dec. 1, 1907.	Date of last calving.	Number of days milking.	Lbs. milk.	Average per cent. of fat in milk.	Lbs. of fat in milk.	Lbs. butter, adding 1/6 to fat.	Value of fat at 25c. per lb. $ c.	Cost of feed. $ c.	Profit over cost of feed. $ c.
Molly DeK.	H.	6	Feb. '08.	298	12,963	3.3	429.06	500.57	107 26	54 48	52 78
Lady S. 2nd........	H.	4	Apr. '08.	337	11,458	3.45	394.92	460.74	98 72	45 [illegible]	[illegible] 31
Boutsje..............	H.	5	Mar. '08.	331	11,665	3.33	388.61	453.[illegible]8	97 13	[illegible]	45 68
Marjorie C....	H.	4	Apr. '08.	341	10,864	3.36	364.53	425.28	91 11	45 41	45 70
Abby M.............	H.	7	Dec. '08.	272	9,730	3.6	349.91	408.23	87 46	46 59	40 87
Minnie of E. S.......	A.	*3*	*Oct. '08.*	*304*	*9,109*	*3.66*	*333.40*	*388.96*	*83 34*	*44 21*	*39 13*
May Queen	A.	6	Mar. '08.	321	8,527	3.74	319.31	372.53	79 81	41 91	37 90
L. Nancie 2nd	A.	7	Mar. '08.	277	8,326	3.8	317.63	370.57	79 41	38 23	41 18
B. Buttercup.........	J.	10	Sept. '07.	366	6,156	5.07	312.32	364.67	78 08	37 20	40 88
S. Ramona...........	J.	6	Oct. '07.	366	7,044	4.33	305.34	356.23	76 33	37 52	38 81
Lady R., O.A.C......	H.	*5*	*July, '07.*	*366*	*8,326*	*3.66*	*305.14*	*355.99*	*76 27*	*44 69*	*31 58*
Adelaide.	H.	8	July, '08.	274	8,199	3.5	287.51	335.43	71 86	43 62	28 24
Molly N., O.A.C....	H.	3	Aug. '08.	341	8.368	3.43	286.94	334.76	71 73	[illegible] 13	27 60
Tibby F.	A.	2	Sept. '08.	340	7,111	4.0	283.79	331.08	70 93	39 75	31 18
Buttercup's Q........	J.	9	Dec. '07.	355	5,379	5.2	282.00	329.00	70 47	37 95	32 52
Toitilla..............	H.	6	Nov. '08.	251	8,283	3.38	279.83	326.47	69 95	46 76	23 19
Inka M..............	H.	8	May, '08.	244	8,408	3.3	278.21	324.58	69 54	35 18	34 36
Dewdrop's A	*J.*	*6*	*June, '08.*	*360*	*5,183*	*5.1*	*263.76*	*307.72*	*65 93*	*37 62*	*28 31*
Beauty, O.A.C.......	H.	3	Jan. '08.	279	8,385	3.02	253.11	295.29	63 25	42 61	20 64
Denty 10th.	A.	9	Aug. '08.	265	5,072	4.9	249.01	290.51	62 24	34 60	27 64
White Rose..........	A.	4	Aug. '08.	316	6,028	4.1	248.27	289.65	62 05	39 04	23 01
Mercena N...........	H.	3	Nov. '08.	298	6,972	2.98	207.57	242.16	51 89	40 91	10 98
Dainty 3rd...........	A.	8	Aug. '08.	239	5,408	3.54	191.39	223.28	47 82	35 02	12 80
Abby M. N..........	H.	2	May, '08.	193	6,053	3.01	182.54	212.96	45 64	17 87	27 77
Dreamy..............	*J.*	[illegible]	*Oct. '08.*	*302*	*3,658*	*5.0*	*182.46*	*212.87*	*45 60*	*31 3[illegible]*	*14 27*
Margaret C	H.	2	June, '08.	168	4,187	3.09	129.40	150.96	32 34	15 43	16 91
Average of 26 cows..				299.8	7,725	3.7	285.61	335.21	71 40	39 57	31 [illegible]

NOTES ON DAIRY HERD RECORD.

1. In the column denoting breed, "A" stands for Ayrshire, "H" for Holstein, and "J" for Jersey.

2. The cows are ranked in order of production of butter fat.

3. An accurate record of food consumed has not been kept, but occasional weighings have enabled us to make a reasonably close estimate.

4. Foods are valued as follows: Meal and bran, $20.00; oil cake, *$32.00; hay, $8.00; roots, $2.00; and silage, $2.00 per ton.* Pasture is charged at $1.00 per month per cow. In some cases, these values are below market prices, but we have retained the method employed last year so that results of the two years may be comparable.

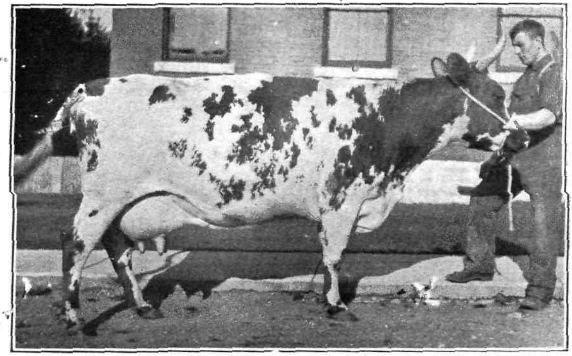
5. In the case of heifers with their first calf, food has been charged only since calving.

6. "Denty 10th," "Dainty 3rd." and "White Rose" are recently imported Ayrshire cows. They had previously calved in the spring, and were purposely held over for later calving. Thus their records include a long period of "stripping," which fact, coupled with the radical change in conditions, has materially interfered with their showing. These cows should give a good account of themselves another year. Denty's recent performance is referred to in another place.

7. "Boutsje," the famous Holstein cow of last year, has done well, but nothing like last year's performance. This is due to the fact that she met with an unfortunate accident during the summer.

8. "Abby M. N.," (Abby Mercena Netherland) dropped her first calf in May. Though she is third from the bottom of the list, she has made a remarkably good showing under the circumstances, and is a heifer we value very highly. Her average milk production per day since calving is 31.3 pounds.

9. The herd record includes every female giving milk in the herd, except one cow, which we very recently purchased.



A good Ayrshire Cow. Denty 10th of Auchenbrain (imp.) —24,739—. Owned by Ontario Agricultural College. Record: September, 1,301 lbs. milk, testing 5.6 per cent. fat; October, 1,200 lbs. milk, testing 5.3 per cent. fat; November, 977 lbs. milk, testing 5.2 per cent. fat. Total for 3 months: Milk, 3,478 lbs.; fat, 187.2 lbs.; butter (obtained by adding ⅙ to fat), 218.2 lbs. This is the first time Denty has "freshened" since she was imported.

Experiments with Dairy Cows.

During the winter of 1907-08, Mr. P. H. Moore, a senior student, wished to conduct some experimental work in feeding dairy cows as a basis for his thesis. We, therefore, allowed him to conduct certain experiments under our supervision, so that we regard the results as belonging to our department.

The principal work consisted of comparing two dairy foods manufactured by the Quaker Oats Company, of Peterboro, with bran and oats. The two foods in question are known as Molac Dairy Food and Schumacher.

Three experiments were conducted. One with oats and bran against oats and Molac, one with bran and oats against bran and Schumacher, and one with bran and oats against Molac and Schumacher. The third experiment was intended as a sort of check experiment, and it brings out a very peculiar feature which is worthy of special notice, and renders it necessary to take all three experiments into consideration before drawing any conclusions.

Each experiment is divided into three periods. During the first period the cows were fed bran and oats, during the second period they were fed the food desired to compare with bran and oats, and during the third period they were fed bran and oats again. In making comparisons, the average of the first and third periods is compared with the middle period.

The results given in the tables do not include the first week after each change in food, one week being allowed to elapse to enable the cows to become accustomed to the change in food.

In addition to the concentrates, the cows were fed cut hay, silage, and mangels, the bulky part of the ration being the same for each cow throughout the experiment.

It will be noted that in the first experiment the rations are identical, except that Molac was substituted for bran in the middle period. This admits of a comparison of Molac and bran when fed in conjunction with oats.

In the second experiment, the rations are identical, except that Schumacher was substituted for oats during the middle period, so that we have a comparison of Schumacher with oats when fed in conjunction with bran.

The amount of Molac fed in the first experiment was less than the amount of bran, and the Schumacher fed in the second experiment was less than the amount of oats. It might have been more satisfactory had the amounts been equal in each case, but the reduction was made because it is claimed that Molac contains more nutriment than bran, and that Schumacher contains more nutriment than oats, and an attempt was made to equalize the rations.

Three cows were used in each of the first two experiments, and six cows in the third. The following tables show results:

MOLAC DAIRY FOOD *vs.* BRAN.

Table Showing Milk and Fat Produced and Concentrates Consumed by Three Cows.

—	Period I. Two weeks, Oats and Bran.	Period III., Two weeks, Oats and Bran.	Average of Periods I. & III. Two weeks Oats and Bran.	Period II., Two weeks, Oats and Molac Dairy Food.
Total milk produced by 3 cows...	1,137 lbs.	1,024 lbs.	1,085.5 lbs.	1,074 lbs.
Average milk, per cow, per day..	27.07 lbs.	24.38 lbs.	25.71 lbs.	25.57 lbs.
Average per cent. of fat..........	3.79	3.9	3.85	3.76
Total fat produced by 3 cows	43.167 lbs.	40.02 lbs.	41.5935 lbs.	40.416 lbs.
Average fat, per cow, per day....	1.028 lbs.	.953 lbs.	.99 lb.	.962 lb.
Concentrates consumed by 3 cows	Oats, 168 lbs. Bran, 210 lbs.	Oats, 168 lbs. Bran, 210 lbs.	Oats, 168 lbs. Bran, 210 lbs.	Oats, 168 lbs. Molac, 168 lbs.
Bran or Molac consumed per 100 lbs. fat produced.	....	....	Bran, 504.88 lbs.	Molac, 415.67 lbs.
Relative value of Bran and Molac for producing butter fat........	....	....	Bran, 100.	Molac, 121.4

SCHUMACHER *vs.* OATS.

Table Showing Milk and Fat Produced and Concentrates Consumed by Three Cows.

—	Period I., Two weeks, Bran and Oats.	Period III., Two weeks, Bran and Oats.	Average of Periods I. and III. Two weeks, Bran and Oats.	Period II. Two weeks, Bran and Schumacher.
Total milk produced by 3 cows ..	1,563 lbs.	1,415 lbs.	1,489 lbs.	1,404 lbs.
Average milk per cow per day ...	37.21 lbs.	33.69 lbs.	35.45 lbs.	33.43 lbs.
Average per cent. of fat	3.56	3.81	3.68	3.45
Total fat produced by 3 cows	55.642 lbs.	33.960 lbs.	64.801 lbs.	48.375 lbs.
Average fat, per cow, per day....	1.325 lbs.	1.285 lbs.	1.305 lb.	1.152 lb.
Concentrates consumed by 3 cows	Bran, 224 lbs. Oats, 182 lbs.	Bran, 224 lbs. Oats, 182 lbs.	Bran, 224 lbs. Oats. 182 lbs.	Bran, 224 lbs. Schumacher, 140 lbs.
Oats or Schumacher consumed per 100 lbs fat produced.	....	....	332.1 lbs.	289.4 lbs.
Relative value of Oats and Schumacher for producing butter fat	....	....	Oats, 100.	Schumacher, 114.7

MOLAC AND SCHUMACHER *vs.* OATS AND BRAN.

Table Showing Milk and Fat Produced and Concentrates Consumed by Six Cows.

—	Period I., One week, Bran and Oats.	Period III., One week, Bran and Oats.	Average of Periods I. and III. One week, Bran and Oats.	Period II., One week, Molac and Schumacher.
Total milk produced by 6 cows...	1,204 lbs.	1,050 lbs.	1,127 lbs.	1,173 lbs.
Average milk, per cow, per day ..	28.66 lbs.	25. lbs.	26.83 lbs.	27.93 lbs.
Average per cent. of fat	3.92	4.04	3.98	3.74
Total fat produced by 6 cows.....	47.27 lbs.	42.524 lbs.	44.892 lbs.	43.962 lbs.
Average fat, per cow, per day....	1.125 lb.	1.012 lb.	1.068 lb.	1.047 lb.
Concentrates consumed by 6 cows	Bran, 217 lbs. Oats, 175 lbs.	Bran, 217 lbs. Oats, 175 lbs.	Bran, 217 lbs. Oats, 175 lbs	Molac, 217 lbs. Schumacher, 175 lbs.
Concentrates consumed per 100 lbs. fat produced.	....	....	Bran and Oats, 891.6 lbs.	Molac and Schumacher, 873.1 lbs.
Relative value of Oats and Bran *vs.* Molac and Schumacher for producing butter fat.	....	....	Bran and Oats, 100	Molac and Schumacher, 102.1

DISCUSSION OF RESULTS.

1. In the comparison of molac and bran, there was a slight falling off in milk yield and per cent. of fat during the time molac was fed. This would indicate that the ration was scarcely equal to the oats and bran, and that feeding less molac than bran was scarcely warranted.

2. The falling off in production was only slight, and when we take the molac consumed per 100 pounds, butter fat produced, molac shows a decided advantage over bran.

3. The falling off in milk and per cent. of fat was quite marked when Schumacher was substituted for oats, and it looks as if more Schumacher should have been fed.

4. The amount of Schumacher consumed per 100 pounds fat produced, was less than the amount of oats, which would make it appear that Schumacher was superior to oats.

5. In the third experiment, equal quantities of molac and bran, and equal quantities of Schumacher and oats were used, and here it will be seen that the yield of milk increased during the time the cows were on Molac and Schumacher, but the per cent. of fat slightly decreased.

6. The increase in production where Molac and Schumacher were fed against equal quantities of oats and bran, is not what one would expect from the results of the two previous experiments, but this point is seen more clearly when we take relative values, as follow in the next section.

7. In the comparison of Molac and bran, we found that if we represented the feeding value of bran as a producer of butter fat as 100, the value of Molac would be 121.4 or 21.4 per cent. higher feeding value than bran.

Peace and plenty.

By the same method of comparison, Schumacher showed 14.7 per cent. higher feeding value than oats. But Molac and Schumacher combined showed only 2.1 per cent. higher feeding value than oats and bran combined.

8. *It would look, therefore, that if as much* Molac had been fed as was fed of bran in the comparison of these two foods, the Molac would not have made such a favourable showing as compared with bran in the production of butter fat. It is quite probable that the effects of the liberal feeding of the first period was carried over into the second period, and that Molac reaped the advantage of it. Had the milk flow been maintained during the time Molac was fed, there would be no ground for this claim.

9. The same conclusion may be drawn regarding Schumacher as compared with oats.

10. There seems to be no doubt that the values of Molac as compared with bran, and Schumacher as compared with oats as shown in the first two experiments, are rather high.

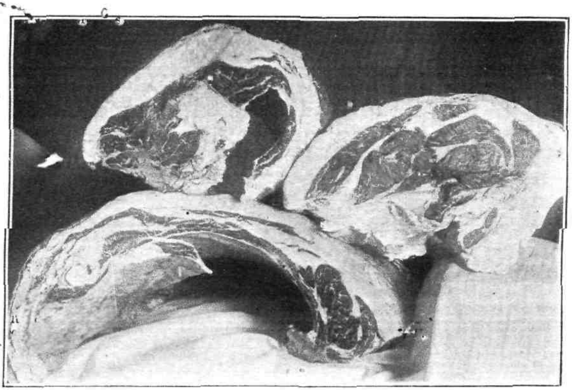
11. It would further appear that both Schumacher and Molac give better results when fed as only part of the concentrates, than when they comprise the total concentrates of a ration.

12. Both these feeds seem to be valuable dairy foods, but their uniformity of composition within reasonable limits should be guaranteed.

FATTENING STEERS FOR EXPORT.

Short Keep vs. Long Keep Steers.

As stated in previous reports, we define short keep steers as heavy, fleshy steers which can be finished for export by stall feeding for two or three months. Long keep steers are lighter and thinner than the short keep, and may require five or six months' stall feeding to fit them for market. This year's experiment is a continuation of the work conducted during the two previous years, and makes the third experiment of the series.



Porterhouse, sirloin, and rib cuts from cross-bred Angus-Shorthorn steer, bred and fed by Ontario Agricultural College. Age when slaughtered, 2 years 27 days. Live weight, 1,650 lbs. Dressed weight, 1,121 lbs. Per cent. dressed carcase, 67.9 per cent.

Plan of Experiment. Eight steers were used in each group, but one of the long keep steers proved to be a very unsatisfactory feeder and was dropped from the experiment soon after its commencement, leaving seven steers in the long keep group. The steers were all tied in stalls, and their ration consisted of meal, hay, straw, roots, and silage. The meal ration during most of the time consisted of ground barley and bran in the proportion of about three parts barley to one of bran. During part of the time, a small proportion of frozen wheat was substituted for part of the barley.

The short keep steers were started on between four and five pounds of meal each per day, and this quantity was increased as rapidly as we deemed

safe, their maximum meal ration being between eight and nine pounds each per day. On an average, they received .559 pound (a little over ½ lb.) of meal per day per one hundred pounds of their average live weight. They were fed for seventy-seven days.

The long keep steers were started on about half the quantity of meal fed to the short keep steers, and increased more gradually. They were fed for one hundred and sixty-eight days, and averaged .56 lb. (practically the same as the short keep) of meal per day per one hundred pounds of their average live weight.

The following table gives some details of weights and gains:

TABLE SHOWING WEIGHTS, GAINS, AND FOOD CONSUMED BY SHORT KEEP AND LONG KEEP STEERS.

	Group 1. 8 steers. Short keep.	Group 2. 7 steers. Long keep.
Average weight of steers at commencement of experiment	1,231.2 lbs.	1,085 lbs.
Average weight of steers at close of experiment	1,404.4 lbs.	1,421.4 lbs.
Number of days on experiment	77 days.	168 days.
Average gain per steer	173.2 lbs.	336.4 lbs.
Average daily gain per steer	2.25 lbs.	2 lbs.
Food consumed	Meal, 4,533 lbs. Hay, 5,325 " Straw, 1,025 " Roots, 12,820 " Silage, 12,820 "	Meal, 8,250 lbs. Hay, [illegible],260 " Straw, 6,937 " Roots. 25,659 " Silage, 25,659 "
Average meal consumed per day per 100 lbs. average live weight of steers	.559 lb.	.56 lb.

The table which appears above gives a clear idea of the food consumed by the steers and what they did with it, but the most difficult point has not been touched, namely, the returns made in dollars and cents by the two groups. Money returns are influenced more by market conditions than by the use the steers make of their food. For this reason, we have attempted to show value received for foods consumed by the steers in three years' experiments, under different prices paid and received for the steers. It is impossible, of course, to treat of all the varying market prices of steers, and we must therefore be content with a few typical cases.

An unsatisfactory feature of steer feeding is the fact that if a steer is driven from the pasture field to the scales, and immediately afterwards tied in the stable, it will almost invariably be found that after a few days in the stable he will weigh less than he did when he came off the pasture. We have sometimes found this difference to amount to fifty or sixty pounds per head, and as our calculations are based upon stable weights, we have not thought it worth while to consider a lower cost than 4 cents per pound for long keep steers. For the same reason, we have made the maximum cost of short keep steers a little high, namely 5 cents per pound. As to the selling price we have made it range from 5 cents to 5½ cents per pound. It is true that export steers have quite frequently sold at over 5½ cents per pound during recent years, but a maximum of 5½ cents is conservative, and will answer for purposes of comparison.

The following table shows results of three years' work:

TABLE SHOWING PRICES RECEIVED PER TON FOR MEAL UNDER DIFFERENT MARKET PRICES FOR STEERS, ALLOWING $12.00 PER TON FOR HAY; $6.00 FOR STRAW; $2.00 FOR SILAGE; AND 10C PER BUSHEL FOR ROOTS. THE TABLE SHOWS RESULTS OF EACH OF THREE YEARS, AND AVERAGE OF THREE YEARS.

	1906.		1907.		1908.		Average of three years.	
	Short keep.	Long keep.	Short keep.	Long keep.	Short keep.	Long keep.	Short keep.	Long keep.
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
If bought at 5c. and sold at 5½c. per lb...	27 39	3 29	26 04	14 41	24 80	10 80	26 08	9 50
If bought at 4¾c. and sold at 5½c. per lb...	41 77	9 25	36 85	21 25	35 66	15 40	38 09	15 30
If bought at 4½c. and sold at 5½c. per lb...	55 99	15 22	47 66	28 09	46 53	20 00	50 06	21 10
If bought at 4¼c. and sold at 5½c. per lb...	70 20	21 18	58 47	34 93	57 39	24 60	62 02	26 90
If bought at 4c. and sold at 5½c. per lb...	84 42	27 15	69 28	41 77	68 25	29 20	73 98	32 71
If bought at 4c. and sold at 5¼c. per lb...	69 20	19 78	57 20	33 49	55 86	23 23	60 75	25 50
If bought at 4c. and sold at 5c. per lb....	53 97	12 41	45 12	25 20	43 47	17 26	47 52	18 29

In making our calculations, we have made certain fixed charges for the bulky fodders. In each calculation hay is charged at $12.00 per ton; straw, $6.00 per ton; roots, 10 cents per bushel; and silage, $2.00 per ton. The total value of the bulky fodders at the prices quoted has been deducted, in each case, from the difference between the total cost and total selling price of the steers, and whatever is left is what was received for the meal consumed by the steers. It will be noted that in some cases very high returns are given for meal consumed, but these are cases where there is a wide spread between the buying and selling price per pound of short keep steers. As it is practically impossible to obtain a wide spread in prices for short keep steers, it would not be worth while including these figures were it not for the purpose of bringing out more clearly the difference between short keep and long keep steers. So long as the reader keeps this fact in mind, the figures will not be misleading.

NOTES ON RESULTS.

1. No charge is made for labor, and no credit given for manure.

2. It will be noted that when bought at 5 cents per lb. and sold at 5½ cents per lb., the short keep steers gave an average return of $26.08 per ton for meal consumed, which may be regarded as a very satisfactory showing for such a narrow spread between the buying and selling price.

3. The long keep steers, when bought at 4¼ cents per lb. and sold at 5½ cents per lb. gave an average value of $26.90 per ton for meal consumed. Thus, a spread of 1¼ cents per lb. in the case of the long keep steers gave very little better returns than a spread of ½ cent per lb. in the case of the short keep steers.

4. It is useless to expect a wide spread between the buying and selling prices of short keep steers, but the high value which short keep steers would return for meal consumed, under a wide spread, brings out a strong contrast between the two classes of steers. Furthermore, the returns made by the long keep steers show very clearly the absolute necessity for a wide spread in prices in the case of long keep steers, because, even under the maximum spread of 1½ cents per lb., the long keep steers did not return particularly high prices for food consumed.

5. So far as these results go, they indicate that steers which can be finished with about two months of feeding, may give fairly satisfactory returns with a spread of ½ cent per lb. between the buying and selling prices; but with steers which have to be fed five or six months, the feeder is hardly safe with a spread of less than 1¼ cents per pound.

6. The marked advantage of the short keep over the long keep steers is due to two things: (1) The greater original weight of the short keep steer, upon which the owner gets the advantage of the spread between the buying and selling price per pound; (2) The smaller amount of expensive meat which it is necessary for the owner to put upon the short keep steer to make him fit for the market.

Feeding Steers Loose vs. Tied.

In this experiment, the eight short keep steers used in the experiment with short keep *vs.* long keep steers, were compared with four short keep steers fed in a loose box. Owing to lack of accommodation, we were unable to have as many loose steers as we had of tied steers.

The method of feeding the tied short keep steers has already been described, and the loose steers were fed practically the same, except that they had better appetites than the tied steers, and we aimed to supply them accordingly.

This is the third experiment of the kind.

The table which follows gives some details regarding the steers:

Table Showing Weights, Gains, and Food Consumed by Tied and Loose Steers.

	Group I. 8 steers. Tied.	Group II. 4 steers. Loose.
Average weight of steers at commencement of experiment	1,231.2 lbs.	1,141.25 lbs.
Average weight of steers at close of experiment	1,404.4 lbs.	1,353.75 lbs.
Number of days on experiment	77 days.	77 days.
Average gain per steer	173.2 lbs.	212.5 lbs.
Average daily gain per steer	2.25 lbs.	2.78 lbs.
Food consumed	Meal, 4,533 lbs. Hay, 5,325 " Straw, 1,025 " Roots, 12,820 " Silage, 12,820 "	Meal, 2,399 lbs. Hay, 2,692 " Straw, 600 " Roots, 6,704 " Silage, 6,704 "
Average meal consumed per day per 100 lbs. average live weight of steers	.559 lbs.	.624 lbs.

It is worthy of note that the loose steers in each of the three experiments ate more than the tied steers, and made larger gains. If values are attached to all the foods they consumed, they show a lower cost per pound of increase than the tied steers in each experiment.

In the table which follows, the two groups have been compared upon the basis of value returned for food consumed, the same as was done in the case of the short and long keep groups, but we have taken fewer variations in price. These are both short keep groups, and there would be nothing gained by including such wide spreads in prices as was necessary when dealing with long keep steeers.

Table Showing Value Returned per Ton for Meal Consumed by Tied and Loose Steers, Assuming that Hay is Worth $12.00, Straw $6.00, and Silage $2.00 per ton, and Roots 10c per bushel, the Table Shows Results for Three Years, and Average of Three Years.

	1906.		1907.		1908.		Average of three years.	
	Tied.	Loose.	Tied.	Loose.	Tied.	Loose.	Tied.	Loose.
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
If bought at 5c. and sold at 5½c. per lb...	27 39	34 49	26 04	26 19	24 80	28 13	26 08	29 60
If bought at 4¾c. and sold at 5½c. per lb...	41 77	48 12	36 85	36 18	35 66	37 65	38 09	40 65
If bought at 4½c. and sold at 5½c. per lb...	55 99	61 75	47 66	46 17	46 53	47 17	50 06	51 70

Notes on Table.

1. It will be noted that the loose steers have a decided advantage over the tied steers in returns for food consumed, in the average of three experiments.

2. The loose steers were handicapped in these experiments by being lighter than the tied steers. It is due solely to this fact that the tied steers show a slight advantage over the loose steers in 1907. Had the two groups been equal in average weight, the loose steers would have made the better showing. In 1906 and 1908, the loose steers were able to overcome their handicap of lighter weight.

3. Our experience leads us to believe that it is more profitable to feed steers loose than to tie them in stalls.

4. Loose steers are less easily surfeited, are less likely to become crippled or sore in their feet, and appear to shrink less when driven to market.

EXPERIMENTS WITH SWINE.

Comparison of Various Dairy By-Products as Foods for Swine.

Owing to the interest which the manufacture of whey butter has aroused of late, we thought it advisable to compare separated whey with ordinary whey as a food for swine. In addition to comparing these two foods, we also compared skim milk and buttermilk with whey.

Plan of Experiment. Originally, 60 pigs were divided into five groups of twelve pigs each, but it was thought advisable to discard certain pigs as unfit for experimental work, and the experiment was completed with the number of pigs in each group indicated in the table which follows:—

Group I. was fed skim milk and meal; Group II., buttermilk and meal; Group III, ordinary whey and meal; Group IV., separated whey and meal; and Group V. was a check group fed water and meal.

The grain ration consisted of barley and frozen wheat, to which wheat middlings were added in the following proportions by weight; 1st, 30 days, 3 parts middlings to 1 part ground grain; 2nd, 30 days, 2 parts middlings to 1 part ground grain; 3rd, 30 days, 1 part middlings to 1 part ground grain; 4th, 30 days, 1 part middlings to 2 parts ground grain.

Nearly two and a half pounds of milk and buttermilk were fed with each pound of meal, and about two and three-quarter pounds of whey with each pound of meal.

Table Showing Weights, Gains, and Food Consumed.

	Group 1. 11 pigs. Skim-milk and meal.	Group II. 12 pigs. Butter-milk and meal.	Group III. 11 pigs. Ordinary whey and meal.	Group IV. 10 pigs. Separated whey and meal.	Group V. 12 pigs. Water and meal.
Duration of experiment.....	120 days.	120 days.	120 days.	120 days.	120 days.
Weight of pigs at commencement of experiment......	485 lbs.	573 lbs.	450 lbs.	427 lbs.	541 lbs.
Weight of pigs at close of experiment...............	2,278 lbs.	2,480 lbs.	1,987 lbs.	1,713 lbs.	1,548 lbs.
Total gain in weight........	1,793 lbs.	1,907 lbs.	1,537 lbs.	1,286 lbs.	1,007 lbs.
Average daily gain per pig..	1.36 lb.	1.32 lb.	1.16 lb.	1.07 lb.	0.7 lb.
Total food consumed	Meal, 4,553 lbs. Skim-milk, 11,223 lbs.	Meal, 4,888 lbs. Butter-milk. 12,042 lbs.	Meal, 4,142 lbs. Whey, 11,486 lbs.	Meal, 3,821 lbs. Whey, 9,959 lbs.	Meal, 4,331 lbs.
Food consumed per 100 lbs. *increase in weight*........	Meal, 254 lbs. Skim-milk, 626 lbs.	Meal, 256 lbs. Butter-milk. 631 lbs.	Meal, 269 lbs. Whey, 747 lbs.	Meal, 297 lbs. S. whey, 774 lbs.	Meal, 430 lbs.

Points of Interest.

1. Skim milk gave the largest gain per pig, as well as the most economical gain.

2. *Buttermilk came so close to skim milk in feeding value, that it may* **be regarded as practically equal to skim milk, so far as this experiment goes.**

3. Ordinary whey shows a distinct advantage over separated whey in this experiment.

4. If we compare each group with our check group, we find that if we represent the feeding value of separated whey by 100, the feeding value of ordinary whey would be approximately 125, buttermilk 160, and skim milk 163.5. That is to say, ordinary whey showed a feeding value 25 per cent. higher than that of separated whey in this experiment, buttermilk 60 per cent. higher, and skim milk 63½ per cent. higher.

5. The feeding value of each kind of whey compared with skim milk is much higher in this experiment than in any other we have conducted, and we feel sure that it is a great deal higher than may ordinarily be expected. It will be noticed that we fed a comparatively small proportion of whey to meal, and under such conditions, whey will always show a much higher feeding value per 100 pounds than when fed in larger quantities. The same is true of skim milk and buttermilk, but perhaps not quite to the same extent. There is little doubt, however, that the use of small proportions of these dairy by-products has tended to bring them more closely together in feeding value. As ordinarily fed whey seldom shows a value higher than one-half that of skim milk or buttermilk.

BARLEY VS. FROZEN WHEAT.

Frozen wheat is a product which varies extremely in quality, and, therefore, is an unsatisfactory food with which to experiment. The frozen wheat used in this experiment tested only 43½ pounds to the bushel, so that it was not a high class sample by any means.

Wheat middlings were fed with the wheat and barley. During the first 30 days, the middlings constituted seventy-five per cent. of the meal ration; *during the second 30 days, sixty-six per cent.; during the third 30 days*, fifty per cent.; and during the last 30 days, thirty-three per cent.

Three groups of pigs were used. Group I, was fed barley and middlings; Group II, frozen wheat and middlings; and Group III, a mixture of equal parts barley and frozen wheat, to which was added the same proportion of midlings as was used in the other two groups.

Some dairy by-products were used, but in the table which follows, the dairy by-products are reduced to their meal equivalent, according to the relative values obtained for these foods in the experiment previously described. All groups fared equally in regard to dairy by-products.

TABLE SHOWING WEIGHTS, GAINS, AND FOOD CONSUMED.

——	Group I. 18 Pigs. Barley and Middlings.	Group II. 20 Pigs. Frozen Wheat and Middlings.	Group III. 18 Pigs. Barley, Frozen Wheat and Middlings.
Duration of experiment	120 days.	120 days.	120 days.
Total weight of hogs at beginning of experiment	740 lbs.	754 lbs.	982 lbs.
Total weight of hogs at close of experiment	3,064 lbs.	3,407 lbs.	3,535 lbs.
Total increase in weight	2,324 lbs.	2,653 lbs.	2,553 lbs.
Daily increase per pig	1.08 lb.	1.1 lb.	1.18 lb.
Total meal or its equivalent consumed	10,015 lbs.	11,325 lbs.	11,052 lbs.
Meal, or its equivalent, consumed per 100 lbs. increase in weight.	430.9 lbs.	431.4 lbs.	432.9 lbs.

Notes on Results.

1. It will be noted that the results from the frozen wheat and barley are extremely close, both in rate of gain and in food consumed per 100 pounds gain.

2. The difference between the food required for 100 pounds gain with barley as compared with frozen wheat is so slight that it may be disregarded. A wider difference might easily be obtained where the same food was employed in each group.

3. Group III, which was fed the mixture, made slightly larger but more expensive gains than the other two groups. Here, again, the difference is so slight that it cannot, with certainity, be assumed that it was caused by any difference in the foods.

4. In this experiment, therefore, the frozen wheat which was employed, proved practically equal to a good quality of barley in the results obtained.

In concluding my report, I wish to bear testimony to the excellent work of my assistant, Mr. R. W. Wade, and to state that this report may be considered as practically a joint report of Mr. Wade and myself.

Respectfully submitted,

G. E. DAY.

PART XII.

THE LECTURER IN HORTICULTURE.

To the President of the Ontario Agricultural College:

SIR,—I beg to present herewith the annual report of the Lecturer in Horticulture.

The first annual Short Course in Horticulture was held from January 27th to February 8th, 1908. The total attendance, exclusive of students and others connected with the College, was seventy-eight, which was felt to be very gratifying. The thanks of this department are due those who so ably assisted.

Addresses on various topics connected with fruit growing were delivered at the following places in connection with special Fruit Institutes: Grimsby, Trenton, Leamington, Jordan, Thornbury, Meaford, Simcoe, Dunnville, Oshawa, Owen Sound, Iroquois and Picton. This phase of the work brings one into close contact with growers in all parts of the country and would seem to be particularly desirable for all concerned.

I also enjoyed a few days in attendance at the Graduate School of Agriculture held at Cornell University in the same month. One comes in contact at such places with the leaders in one's own kind of work, and great benefit is thereby gained.

The lecture work in this department has been extended during the year by the addition of pratical work in fruit growing for the Freshman class in the spring term, and also by the addition of practical work with fruit and vegetables during the fall term of the Second year. Owing to the large size of the classes, considerable repetition is necessary, and this, of course, means much additional work. Slight changes have been made in the other courses, but in general this work has proceeded on much the same lines as in former years.

New equipment has been added in the shape of a fruit and vegetable storage house, which was sorely needed. This building is thirty-three by forty-three feet, with a basement for vegetables and first floor for fruit storage. A double cottage to be occupied by Mr. McMeans and Mr. Hunt has also been provided. These two buildings cost $3,000 each.

A new and fairly complete line of modern orchard implements has been added this fall. These will be tested so that desirable and little known tools may be brought to the notice of growers generally.

In co-operation with the Department of Entomology, three hives of bees were purchased in the spring and located in the College orchard. These were managed for increase and not for honey, and we now have five swarms going into winter quarters in good condition. They are being wintered out-of-doors because of the lack of a suitable cellar for the purpose.

ORCHARD NOTES.

Trees and plants survived last winter in excellent condition. Little harm was done to raspberry canes or other tender wood, and fruit buds as tender as those of Burbank plum were almost entirely uninjured. This variety bore well, which is somewhat unusual in this locality, as the buds are usually destroyed by alternate freezing and thawing in late winter.

The blooming period of trees was accompanied by ideal warm sunny weather with occasional showers. This was followed by wet, muggy weather, quite favorable to the development of apple and pear scab, and as a consequence those trees unsprayed or poorly sprayed developed considerable quantities of this disease.

The autumn was particularly dry and tree growth matured well in consequence.

Wheat was sown as a cover crop in the college orchard on August 1st. This would be too late to cause thorough ripening of the wood in an average season in this locality, but on account of the unusual lack of rain this fall no harm was done by the delay of seeding.

Good crops were harvested of strawberries, currants, gooseberries, American plums, summer and fall apples, and fair crops of raspberries, cherries, and pears. Most plums other than Americanas were a light crop, as were also winter apples.

About five hundred plants each of several varieties of strawberries were set out in early spring. They have been restricted to hills, and will form the subject of careful studies in connection with the proper methods of improvement to be followed with this fruit and with others of like nature.

Seedling strawberries and raspberries are also under observation, but so far no varieties worthy of introduction have been secured.

FERTILIZATION OF BLOSSOMS.

The following varieties of apples are again recorded as having proven self-fertile:—Duchess, Snow, Ribston, McMahon White, Ontario, Rhode Island Greening.

The following varieties are recorded this year for the first time as having proven self-fertile. Some were tested this season for the first time while others have been tested previously:—Baxter, Gideon, Winter St. Lawrence, Magog, Longfield, Shackleford, Fanny, Bottle Greening, Bismark, Fall Jennetting, Garden Gem, and Transcendant and General Grant crabs.

A large number of blossoms of Northern Spy were carefully emasculated and pollenized by hand with pollen of Spy procured from Trenton, Oshawa, Thornbury, and Jordan. One small fruit formed under pollen from the last named place. This is the first time, so far as the writer is aware, that this variety has ever set fruit by its own pollen, and even in this case the lone specimen borne could hardly be taken to indicate any appreciable degree of self-fertility.

SPRAYING.

Tests were made of the following strengths of lime-sulphur applied for the oyster-shell scale on the dormant wood in early spring:—

(1)	Lime	20 lbs.	Sulphur	15 lbs.	Water	400 lbs.	(40 gallons).
(2)	"	20 "	"	18 "	"	" "	" "
(3)	"	20 "	"	20 "	"	" "	" "
(4)	"	22 "	"	18 "	"	" "	" "

Numbers 2, 3, and 4 proved perfectly satisfactory, and with any one of these formulas the question of controlling the scale is simply one of thorough spraying. Number 1 was scarcely effective enough to be recommended. These experiments demonstrated that the scale can be practically exterminated, even on badly infested trees, by one application if the mixture is properly prepared and *thoroughly* applied. It is advisable to scrape off all rough bark with a dull hoe before spraying for any scale insect.

The mixture was prepared by boiling with steam from a small feed-cooker. It boiled invariably at 208 degrees to 210 degrees F., which approximates normal boiling point of water at this altitude. Boiling for longer periods than one hour failed to render the preparation any more effective.

"Niagara" Brand Lime-Sulphur, a commercial preparation, was applied under the same conditions as above mentioned to trees seriously infested with oyster shell scale, and proved to be fully as satisfactory as any mixture used. It is ready for application simply upon dilution with the requisite quantity of water and on that account is very convenient, especially for the amateur. The proportion used was one part to eight parts of water, whereas the manufacturers recommend it to be used one to eleven. This was done in the absence of the manufacturer's directions and at the suggestion of the Department of Chemistry, after analysis and comparison with the standard home-made material.

This same material was applied as a summer spray on June 5th, at which time the young of the scale were running on the tree. The strength used was one to twenty, and also gave excellent results.

The V I and V II spray mixtures were applied as directed and under most favourable weather conditions to one row of apple trees. Satisfactory results were not secured. In justice to the manufacturers, it should be stated that after the spraying was done, word was received that the V II used had been found by the company's chemist to be incorrectly compounded, or had in some unexplained manner become deteriorated. A second sample of V II was received from the agent later in the season, but too late to be given a fair trial on oyster-shell scale. For an account of a test of this second sample on wooly aphis, see the report on Vegetables.

The general spraying of the college orchard consisted this year in the application of:

(1) Home-made Lime-sulphur at the time buds were swelling but before growth started, with formulæ given above.

(2) Bordeaux Mixture immediately preceding the opening of the blossoms.

(3) Bordeaux immediately after the fall of the bloom.

In the second and third sprayings, an arsenical poison was used, Paris Green being applied to one-half of the orchard and Arsenate of Lead to the other. The quantities used were six ounces Paris Green in one case and two pounds Arsenate of Lead in the other, per forty gallons of water. No appreciable difference in the effectiveness was noted, but it was thought that the slightly higher cost of arsenate of lead was more than compensated by its greater uniformity of application, as well as by its power of adhering longer to the foliage.

The apple scab was almost entirely controlled and some really excellent results were secured on heavily loaded trees of such susceptible varieties as Snow and St. Lawrence.

The number of sprayings given was not sufficient to control the scab on Flemish Beauty pear in those cases where the trees occupied a low situation lacking in atmospheric drainage. On higher ground good results were obtained with this most susceptible variety.

Owing to the fact that our orchard is composed of very many varieties, of which fifty or more may be in bloom in any one season, we are not able to spray for the codling moth as thoroughly as we would wish. It is impracticable to spray each variety at the proper time because of the wide variation in the dates of blooming of different varieties, and because several varieties are planted in the same row without regard to the matter of con-

venience in spraying. Some kinds begin blooming ten days earlier than others, and the same degree of variation occurs in the dates on which bloom falls. The all-important spraying for the codling moth is said to be that applied *immediately* after blooming. At the time when we make this application we have, consequently, varieties in every stage, from *falling bloom* to *bloom fallen as long as ten days*. The results of our observations under these conditions confirm the statement made above regarding the proper time for combatting the codling moth. We find that trees sprayed *during the falling of the bloom or immediately after* give a lower percentage of injury from codling moth.

This phase of protection from injurious insects has an important bearing on the laying out of orchards. It is, of course, desirable in the first place to limit the number of varieties in a commercial orchard. These varieties should then be arranged in so far as possible with a view to facilitating the spraying of *each variety* at the proper time. This is best done by planting either in solid rows or solid blocks of one variety. The writer prefers solid rows as less delay is occasioned by the time taken in turning with the spraying outfit. On no account should varieties blooming at different dates be planted in the same row, or the ground will require to be covered twice in order to do thorough work.

A leaf-spot disease has frequently seriously defoliated both red and black currants in the college plantation. This year an attempt was made to combat this disease, and Bordeaux Mixture of standard formula was applied to black currants on June 4th, at which time the fruit was comparatively small and quite green. This application was partially successful in checking the progress of the trouble. A further attempt was made with red currants, spraying with Bordeaux immediately after picking. The effect of this spraying was very marked, the plants on the sprayed row retaining their foliage considerably later in the season. It is probable that both these sprayings should be made if complete success is to be obtained against this disease.

Strawberry plants are very commonly attacked by a fungous disease of the foliage called "Strawberry Leaf-Spot." Decidedly beneficial results were secured this season by spraying the young plantations twice with Bordeaux. Some of the best growers spray three and even four times for this trouble.

For further information on spraying and spray materials, see the Reports of the Professors of Chemistry and Entomology.

Orchard Diseases.

Mr. R. M. Winslow, B.S.A., District Representative of the Ontario Department of Agriculture, Picton, Ont., called our attention this season to an apple disease very prevalent in Prince Edward County and elsewhere, and of which a good deal was to be found in the College orchards and vicinity. The disease is a canker affecting apple trees particularly, and information regarding its appearance, methods of treatment, etc., can be secured from Mr. Winslow who has published a special bulletin dealing with the subject.

Notes on Varieties.

Following is a list in order of productiveness of the varieties of strawberries which have given the highest yields here for a period of five years or longer: Buster, Parson's Beauty, Wesley, Warfield, Ruby, Fountain, Hero, Clyde, Barton's Eclipse, Williams, Saunders, Bisel, and Splendid.

Of this list the most desirable market varieties in order of ripening are, Splendid, Warfield, Parson's Beauty, Fountain, and Williams.

We are receiving numerous inquiries regarding the Herbert raspberry. This variety has been tested here for some years and has given uniformly good satisfaction. It is slightly earlier than Cuthbert, larger in size, but probably a little softer berry and the plant is very productive. The quality is hardly as good as Cuthbert.

The report on work conducted with vegetables is presented by Mr. McMeans.

VEGETABLE GARDENING.

Vegetable growing and trucking are becoming of more importance each year. Naturally, vegetable gardening is carried on most extensively in the vicinity of the cities and larger towns, although in many of the rural sections certain truck crops are grown on a large scale and shipped to all parts of the country. As an instance, I may say that this year there were grown in the vicinity of Scotland (Brant County), over one hundred and fifty acres of onions.

Addresses on vegetable topics were delivered at a short-course held at Leamington, also at the annual meeting of the Ontario Vegetable Growers' Association, and some of the growing sections were visited during the season. This work brings one into closer touch with the grower, and seems to bring desirable results.

It was the privilege of the writer to spend some weeks in the onion growing sections of the United States, studying their methods of production and marketing. This work was done for the Provincial Department of Agriculture, on behalf of the Ontario Vegetable Growers' Association.

VARIETY TESTS.

Variety tests were carried on to some extent this year with results as follows:

BEANS. The test of garden beans included seventy varieties. Thirty-six of these were what is known as Wax beans and thirty-four were green-podded.

Desirable varieties for home use: For yellow-coloured snaps: Grenell's Rustproof Wax, Keeney's Rustless Golden Wax, Burpee's Kidney Wax, German Black Wax, Pencil Pod Black Wax. For green coloured snaps: Red Valentine, Stringless Green Pod, Henderson's Full Measure, and Refugee. For combination of snaps and green-shell in a single variety: Ruby Horticulture Bush, Warren Bush.

Most productive varieties: Yellow coloured snaps: Hodson Wax, Refugee Wax, Keeney's Rustless Golden Wax. Green coloured snaps: Hodson's Green Pod, Refugee, Improved Early, Round Pod, Valentine.

The results of the variety tests with Beets, Carrots, Cabbage, Celery, and Peas, which have been in progress for some years, are not subject to any important change this year. The list of recommended varieties may be found in last year's report.

ONIONS. Twenty-seven varieties under test. The old standards still prove best, that is, Yellow Globe Danvers, Southport Yellow Globe, and Prizetaker among the yellows; Southport Red Globe and Red Wethersfield among the red varieties. Among the newer varieties on trial this year, the following are promising: Early Rose (Burpee) early, pinkish-rose in colour, flavor mild. New Commercial (Maule) is a prizetaker reduced in size with

keeping quality added. Ebenezer (Johnson), globe-shaped, dark brown i colour, and claimed to be a great keeper.

TOMATOES. Extensive variety tests with tomatoes have been conducte for a number of years. As a rule, only the earliest varieties mature a ful crop in our comparatively short and cool summer season at Guelph. Thi year fifty-four varieties were included in the test. Nine plants of eac variety were set four feet apart in a row, with the rows five feet apart to allo for ease of picking. The plants were set in the field on June 8th, the firs picking was made on August 6th, and the last picking on September 30th

The following table gives the results from twenty of the heaviest yield ing varieties:

Name of Variety.	Source of Seed.	Germination.	Average weight of *fruit per* plant.	Average weight of *individual* fruits.
			ounces.	ounces.
Wealthy	Bolgiano	94	566.1	6.52
Earlibell	Rennie	83	548.5	6.68
Big Victor	Moore & Simon	88	510.1	5.22
Wonderful	" "	80	508.1	6.41
I.X.L.	Bolgiano	92	504.0	6.8
Nolte's Earliest	Gregory	68	493.7	6.5
Mikado	Steele-Briggs	85	485.9	10.36
Jack Rose	Johnson	98	476.0	6.55
Horner's Ex. Early Prolific	Moore & Simon	87	474.0	6.32
Bonny Best	Stokes	100	469.9	6.25
Bond's Minnesota	Gregory	92	465.5	3.89
King of Earliest	Moore & Simons	82	454.3	7.01
Supreme Early	" "	63	451.9	5.45
First of All	Maule	97	447.5	7.47
Hubert's Marvel	Farquhar	72	433.1	4.54
Early Pink	McInnis	82	433.0	7.2
Earliana (Sunnybrook)	Burpee	95	430.8	6.59
Extra Early Red	McInnis	93	424.2	7.27
Sunrise	Gregory	11	418.5	2.72
Express	Sherrington	78	417.2	6.75

The heaviest producing varieties of early tomatoes were as follows This was the average yield per plant from August 6th to August 20th, in clusive: Horner's Early Prolific, 4 lbs. 11 ozs.; Jack Rose, 4 lbs.; Earlian (Sunnybrook), 3 lbs. 10 ozs.; Early Pink (McInnis) and Earlibell, each 3 lbs 9 ozs.; Nolte's Earliest, 3 lbs. 5 ozs.; June Pink (Bolgiano), 3 lbs. 4 ozs. First of All (Maule), and Dominion Day, 2 lbs. 13 ozs.; Extra Early Re (McInnis), 2 lbs. 12 ozs.; Jerrard's New and June Pink (Moore and Simon) 2 lbs. 6 ozs.; Earliest Pink (1115), 2 lbs. 5 ozs.; Express and Bonny Best 2 lbs. 4 ozs.

The heaviest yielders of late tomatoes were as follows: This was th average production, per plant, from September 19th to September 30th A picking was made on September 18th, and we base our figures on two pick ings made after that date, namely, September 23rd and 30th.

Hubert's Marvel, 19 lbs. 1 oz.; Wonderful, 18 lbs. 5 ozs.; Bond's Minne sota, 17 lbs. 7 ozs.; Acme, 16 lbs. 6 ozs.; Greater Baltimore, 15 lbs. 2 ozs. Royal Pink and Freedom, 14 lbs. 11 ozs.; Mikado, 14 lbs. 9 ozs.; May' Favorite, 14 lbs. 4 ozs.; Crimson Cushion, 14 lbs. 3 ozs.; Moore's Triumpl and Superb Salad, 14 lbs. 2 ozs.; Ponderosa and Stone, 14 lbs.; Big Victor 13 lbs. 15 ozs.; Beauty, 13 lbs. 11ozs.

Spraying.

A sample of V II was tested on tomatoes and cucumbers in the greenhouse for red spider and woolly aphis, at strengths of 1 to 100 and 1 to 75, with two applications in each case and an interval of three days between applications. There was no noticeable effect.

Potatoes. The potato beetle and potato blight were satisfactorily controlled with four applications of Bordeaux Mixture and Lead Arsenate, the first two sprayings killing all the beetles and the other two being used as a preventive measure for both beetles and blight.

Asparagus Beetle. These insects were very numerous and troublesome the past summer, but were destroyed and subsequently kept under control by spraying with Resin Bordeaux and poison. Ordinary Bordeaux Mixture will not adhere to the asparagus tops, but Resin Bordeaux was not washed off even by continued rains.

This mixture is made as follows: Melt five pounds of resin with one pint of fish oil over a fire. Cool slightly, add one pound of soda lye with stirring; add five gallons of water and boil until the mixture will dissolve in cold water. Use two gallons of this mixture with forty-eight gallons of Bordeaux. Resin Bordeaux was also applied to onions to test its adhesive qualities, as well as its use as a fungicide in preventing mildew. It adhered remarkably well and although the onions went down with mildew, the strip that was sprayed stood up for several days longer than the strip that was not sprayed.

Seed Selection.

Some valuable work in seed growing and seed selection with Beans, Peas, Sweet Corn, and Cabbage was carried on this year, but as yet results are not sufficiently advanced for publication.

Greenhouse Work.

The growing of vegetables under glass is an industry that has been making advanced strides the past few years. In all the cities and large towns of this Province, there is an ever increasing demand for vegetable products grown under glass. At the present time two of the greenhouses are devoted to that phase of the industry.

Water Cress and Parsley. These crops are well worthy of notice to under-glass gardeners. Placed in the cooler part of the house, they gave a continual supply of crisp, tender leaves throughout the whole winter and were in great demand for relishes and garnishing.

Some experiments in stimulating plants with electricity were carried on in the greenhouse last spring by Mr. B. Hoy. That plants respond to electrical stimuli in various ways is well known. The method used consisted in placing copper and zinc plates in the soil, connected overhead by an insulated copper wire. This formed a cell in itself and generated a current. The results of five experiments with radish sown at different dates during the season gave an average increase of nine per cent. in weight of root and 14.4 per cent. in weight of tops. This extra leaf growth on the radish led us to try a small plot with lettuce. It was treated somewhat differently than the radish, in that plants were used, whereas seed was sown in the case of radish. The following is the result of one experiment in lettuce. Electrically stimulated plants gave an average increased weight of 1.06 ounces per head, or a gain of 12.43 per cent. over plants grown under the same conditions but without electricity.

FORCING TOMATOES. Last year one house was devoted exclusively to the growing of tomatoes under glass. The same house was used this year, growing two crops during the season. Some work with fertilizers on tomatoes was also done, but results do not warrant the publication of the same as yet.

Plants were trained to single stem and spaced two feet apart each way.

The following table shows the relative productiveness of the varieties under test, also the average size of the fruits; but it does not show colour, shape and quality of the fruit. Of the varieties tested, the following are to be recommended:—Lester's Prolific, Hubert's Marvel, of the smaller fruited varieties, and Chalk's Jewel for a variety producing larger fruit.

YIELD OF TOMATOES IN FORCING HOUSE.

Variety.	Sub-irrigated.			Surface watered.			Percentage of gain of sub-irrigated over surface watered.
	Average weight of fruit per plant.	Average number of fruits per plant.	Average weight of individual fruits.	Average weight of fruit per plant.	Average number of fruits per plant.	Average weight of individual fruits.	
	ounces.		ounces.	ounces.		ounces.	p.c.
Lester's Prolific..	121	39	3.1	102	34	3	18
Don..........	109	37	2.94	92	32	2.87	19
Hubert's Marvel.	105	33	3.18	91	30	3.03	15
Comet..........	102	36	3.93	94	24	3.91	8
Chalk's Jewel...	100	19	5.26	75	15	5	33
Frogmore.......	99	25	3.96	71	24	2.96	36
Stirling Castle...	88	26	3.38	79	27	2.92	11
May's Favorite..	83	19	4.38	53	13	4 07	57

It will be noticed in the above table that the sub-irrigated bed gave yields ranging from 8 per cent. to 57 per cent. larger than the yields from surfaced watered beds. The sub-irrigated bed was watered by means of a row of ordinary drain tile, placed lengthwise of the bed on a cement bottom with about six inches of soil in the bed. The water leaking out at the joints of the tile is brought up by capillary action to the feeding roots of the plant, leaving the surface of the soil open. Surface watering, on the other hand, tends to pack the surface soil. Sub-irrigation tends to the production of earlier fruits. It was noticed that tip rot was worse on the surface-watered bed than on the sub-irrigated.

The White Fly was kept in check by fumigation with hydrocyanic acid gas. For a full account of the method of use, see page 150, Report of 1907.

LETTUCE. Two beds of Grand Rapids lettuce of three hundred and twelve plants each were set out with plants eight inches apart. On one sub-irrigation was used, the other being surface-watered. The results were as follows:—

Three hundred and twelve plants on the surface-watered bed produced 1,841 ounces, or an average of 5.9 ounces per head. The same number of plants on the sub-irrigated bed produced 2,006 ounces, or an average of 6.43 ounces per head. This shows a gain in favour of sub-irrigation of .53 ounces per head, or practically nine per cent.

CANNING.

Experiments were begun in 1907 in the use of a home-canning outfit, with the object in mind of determining the practicability of canning fruits and vegetables in a small way. The operations connected with the packing of these materials in tin cans are not at all difficult to perform, and while there are believed to be many cases in which outfits of this kind could be used to advantage, we desire to draw attention to the points which must be considered before undertaking this work. They are: 1. Cost of outfit, cans, etc.; 2, cost or market value and availability of labour; 3, cost or market value of raw materials; 4, value of finished product in the open market. The cases in which it is believed to be possible to use one of these outfits to advantage are: 1. Where there is a supply of raw material for which no other profitable outlet is open. Only in those cases where the market price of the finished product warrants the expenditure of the necessary time and trouble should this means of disposing of a surplus be undertaken. It must be understood that a small outfit cannot put up goods as cheaply as a large factory, and careful calculations should precede every attempt. 2. A number of households might profitably combine in the purchase and operation of a small plant for the production of an excellent article for home consumption. This may be done very economically and a splendid grade of goods may be put up.

We have this year made use of a home canning outfit for the packing of tomatoes, and have put up eight hundred gallon cans in this way. The average number of cans per bushel in this season's work is six and a half. The gallon can, so-called, holds from six and a quarter to six and a half pounds of actual tomatoes. The juice of the tomatoes furnishes all the liquor required. They were exhausted fifteen minutes and processed seventy-five minutes.

Following is a statement of the cost of canning. The plant was operated one or two days each week during the picking season as occasion required. The figures given are for one afternoon's work, and are believed to be representative in all respects of the season's operations:—

110 gallon cans at 6c.	$ 6.60
Freight on cans	.20
17 bush. tomatoes at 27½c	4.67½
1 man washing, scalding, and tending fires, etc., 5 hours at 15c	.75
1 man wiping, capping, sealing, and processing, 6½ hours at 15c	.97½
4 hands peeling and filling cans, 16 hours, at 12½c. per hour	2.00
Solder	.20
Fuel	.50
Depreciation of plant	.75
Interest on capital invested in plant	.37½
	$17.02½
Leaks and swells 2 per cent. loss	.34
Total cost of remaining 98 per cent., or 107.8 cans	$17.36½
Or 16.10c. per gallon can.	

Respectfully submitted,

J. W. CROW.

PART XIII.

THE PROFESSOR OF LANDSCAPE GARDENING.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to present herewith my sixteenth annual report, not, as in previous years, on the whole field of horticulture, but on what may be called the aesthetic branches of that subject, viz., Landscape Gardening and Floriculture.

REORGANIZATION.

I am pleased that horticulture has reached a stage in this Province when specialists are demanded in every branch of the work, and that in accordance with the recommendation made in my last report, the work here has been divided so that we who are engaged in it may concentrate our efforts on those branches which require the most attention. Mr. J. W. Crow has been given charge of that part of the work connected with fruits and vegetables, with Mr. McMeans to assist in the vegetable gardening. Mr. Crow will, therefore, report directly upon the work in connection with fruits and vegetable growing.

I have chosen to specialize upon the aesthetic rather than the economic branches, not merely because these have always strongly appealed to me, but because there appears to be the greatest call for help along these lines at the present time. Requests for information regarding landscape gardening as applied to both rural and civic improvement are coming from all sections of the country more urgent than ever before.

Floriculture has already attained considerable prominence in this country as a commercial industry, and that the interest in it by amateurs is ever increasing is evidenced by the numerous letters received by this department. Mr. Wm. Hunt is in charge of this branch of the work, and his practical talks and demonstrations to our students have proved that he is the right man in the right place. His report will be given herewith.

I. LANDSCAPE GARDENING.

TEACHING. A regular course of instruction in landscape gardening as applied to the beautifying of rural and urban homes has been given to students of the Macdonald Institute taking the Horticulture course, and to sophomore students of the College; while a more advanced course, as outlined in the College calendar, has been given to senior students taking the Horticulture option. To the students attending the summer school, a short course of lectures was given, in which emphasis was placed upon the improvement of school grounds.

Conventions and Meetings.

The re-arrangement of work here has enabled me to attend many more outside meetings than usual. During the year, I have addressed one or more meetings at the following places:—Guelph, Hespeler, Goderich, Chatham, Grimsby, St. Catharines, Waterdown, Durham, Simcoe, Dunnville, London, Walkerville, Amherstburg, Leamington, Hamilton, Smith's Falls, Cardinal, Napanee, Picton, Bowmanville, Woodstock, Waterloo, Galt, Springfield, Port Dover, Oakville, Stirling, and Toronto.

Assistance was also given by judging at exhibitions at the following places:—Simcoe, Guelph, Acton, Fergus, and Toronto.

Improvement of School Grounds.

At the request of the Department of Education, a bulletin was prepared last summer on the "Improvement of School Grounds." This is now in press and will soon be ready for distribution by the Department of Education at Toronto.

We believe that the general improvement of school grounds is one of the important matters requiring the attention of all concerned at the present time, not only because of the educational value of beautiful surroundings on the rising generation, but because the school is one of the centres of interest for every section, and by well laid out and beautifully planted grounds it may be made to afford valuable suggestions for the improvement of home surroundings throughout the section. We are hopefully looking forward to a general advance in this respect in the near future, and will be pleased to communicate with any teacher, inspector, or board of trustees desiring suggestions for the improvement of their school grounds. Plans are now in hand for the improvement of several school grounds upon which the work will be commenced next spring.

Improvements at Other Public Institutions.

At the request of the Inspector of Asylums and Prisons of the Province, I looked over the grounds of the Provincial Asylums at London, Penetanguishene, and Hamilton, and gave suggestions for their improvement. At Penetanguishene, a large part of the grounds in front of the main building needs grading and planting. At the other two institutions, the main thing needed is a judicious thinning of the trees which have become too crowded, and at Hamilton cutting out a large number of spruce scattered about the grounds, the natural beauty of which has been destroyed by the foolish practice of clipping into unnatural form.

Changes on College Grounds.

Alterations and improvements on the College grounds are found necessary from year to year. The most marked change this year being the removal of about forty full-grown Norway spruce in the row along the front of the lawn. These trees were planted twenty-five feet apart in a windbreak thirty-three years ago, and had reached an average height of about sixty feet; but they were getting very unsightly through the dying out of the lower branches, many of which had a spread of ten feet on all sides of the trunk. The killing of the lower branches was no doubt due partly to the shading

by the adjoining row of maples and partly to the strong west winds to which they were exposed. In place of the spruce, groups of hardy shrubs will be planted in a year or two when the ground can be got into good condition.

In this connection I wish to express my appreciation of the valuable services of Wm. Squirrel, foreman in this department. It was he who planted these spruce trees thirty-three years ago, and he who directed operations in their removal this fall.

II. FLORICULTURE.

The following report on the work in floriculture has been prepared by Mr. Wm. Hunt, who has charge of this branch of the work:

TEACHING. The course of instruction as outlined in the College curriculum has been given to the second and fourth year students and to the Macdonald classes taking the course in Horticulture. The summer class in Nature Study taking Elementary Agriculture was also given a series of twelve lectures on floriculture. Each year the necessity for a more extended course in floriculture along commercial lines for the graduating class in horticulture becomes more apparent.

OUTSIDE LECTURES. Lectures have also been delivered to Horticultural Societies at the following places: Owen Sound, Port Elgin, Midland, Barrie, Stratford, Clinton, Mitchell, Seaforth, Hamilton, Elmira, Guelph, Cayuga, Toronto, Walkerton, Collingwood, and Thornbury. At some of these places, I addressed gatherings of school children in the morning or afternoon. Addresses were also given at Ontario Horticultural Association Meeting, Toronto, and at Women's Institute Convention, Guelph.

I also acted as judge at the following Horticultural Exhibitions: Stratford, Elmira, Elora, Fergus, Brantford, Cayuga, Owen Sound, and at the Guelph Central and East Simcoe (Orillia) Fall Fairs.

THE GREENHOUSES.

The greenhouses are taxed to their utmost capacity, as much space as possible being devoted to growing plants suited for the class work. With the increasing classes, necessarily a larger amount of space is required for practical laboratory work.

A number of new chrysanthemums, geraniums, and other plants have been added to our plant list so as to include varieties of recent introduction.

FUMIGATION WITH CYANIDE OF POTASSIUM.

Further tests have been made with the use of hydrocyanic acid gas for exterminating the White Fly (*Aleyrodes vaporariorum*) and the Black Aphis in greenhouses. After repeated tests, there appears to be no reason for changing materially the formula and methods recommended in our last report for the use of cyanide of potassium for the extermination of the White Fly. Experiments were made with the ventilators open about an inch, so as to give somewhat the conditions of a leaky or poorly glazed greenhouse. The greenhouse in which the tests were made is sixty-four feet in length, eighteen feet in width, and eleven feet in height at the ridge, with seven ventilators, each four feet by two feet, placed at regular intervals on one side of the roof. The materials used for fumigation were:—¼ ounce cyanide of potassium, ½ ounce sulphuric acid, 1 ounce water to every thousand cubic feet of space. The material was divided into four equal quantities, four jars being used. The fumigating was done late in the evening. The results could

scarcely be called satisfactory so far as the complete destruction of the fly was concerned, for although many were killed, some live ones yet remained. The tender plants, however, were not injured, as was the case in tests previously reported. The results go to show that a comparatively tight house is necessary to effective fumigation for this pest.

For destroying the Black Aphis or Black Fly on Chrysanthemums, it was found that a stronger application is necessary, about one-half more of each material being required to the one thousand cubic feet of space. Better results also have been obtained by dividing the amount of material used into smaller quantities than first recommended, so as to distribute the fumes as evenly and quickly as possible throughout the entire house. The best results have been attained by having a jar or vessel of the material placed at least every twenty feet throughout the length of the house. The density of the foliage of these plants and the greater vitality of the Black Fly as compared with the White Fly are factors necessitating stronger fumigation.

An easily applied, safe, and effective remedy suitable for amateurs to use for the eradication of the White Fly on house plants has not yet been discovered. The remedies just described should not be attempted in a dwelling house because of the deadly nature of the fumes evolved.

Test of Out-door Roses.

In the spring of 1907, a collection of about one hundred and thirty varieties of roses were planted in the garden, consisting of bush and climbing varieties, including hybrid perpetual, hybrid tea, polyantha and tea roses.

They were given good cultivation and made a fair growth the first season. Various methods were tried of protecting the bushes for the winter. Some of the bush roses were banked with earth for a foot or so about the canes, some were banked with manure only, and some with leaves and strawy manure with board cover. The climbing roses were laid close to the ground and covered with four or five inches of strawy manure. So far as a comparison of results was concerned, but little difference was noticed in the different methods.

Bush Roses. All of these that came through the winter satisfactorily flowered last summer (1908). The hybrid tea varieties, such as American Beauty, Meteor, Richmond, and other tender varieties, were many of them badly winter killed, even where well protected. Some of the more hardy hybrid perpetual varieties budded or grafted on the briar or manetti stock were also winter killed or badly weakened. Bushes on their own roots, while probably not making quite as strong growth as those budded or grafted, came through the winter almost without exception in very good condition. This goes to show that hybrid tea roses, of any variety, are not so desirable for planting outside in this locality or in northern sections of Ontario.

Climbing Roses. There were twenty varieties of climbing roses in the collection, most of which wintered fairly well with the protection given. Maddalena Scalarandis was the only variety killed out entirely, although some of the Polyantha and Soupert type of climbers were partially winter killed. Among the most promising newer varieties in the collection are May Queen, Pearl Queen, Wm. C. Egan, and Queen Alexandra. The last named is a beautiful free blooming, attractive rose, rivalling the popular Crimson Rambler in the size of its panicles of flowers, the color being a pretty pale pink. Further tests must be made, however, before any very definite results can be published.

TENDER TEA, HYBRID TEA, AND POLYANTHA ROSES. Very few of these came through the winter satisfactorily, notwithstanding the careful protection given them. Of those that survived, Hermosa, Baby Rambler, Killarney, Clothilde Soupert, Queen's Scarlet, and Gen. de Tartas came out the best. Hermosa proved to be the hardiest of the lot. The bushes of this variety bloomed profusely the greater part of the summer.

GOOD ROSES FOR AN AMATEUR'S GARDEN.

From the data at hand, we would recommend the following as a few of the most desirable hardy roses for the amateur's garden:—

Hybrid Perpetual Bush Roses.

Abel Carriere. Crimson.
Anna de Diesbach. Pink.
Baron de Bonstetten. Very dark crimson.
Countess de Roseberry. Shell pink.
Dinsmore. Dark crimson.
Eugene Furst. Velvety crimson, shaded maroon.
Earl of Dufferin. Velvety crimson.
Exposition of Brussels. Dark purple crimson, fiery centre.
Francois Levet. Rosy crimson.
Frau Karl Druschki. White.
General Jacqueminot. Scarlet crimson.
Jean Liabaud. Deep crimson.
John Hopper. Rosy pink.
Louis Van Houtte. Dark cherry red.
Marshal P. Wilder. Dark red.
Oakmont. Soft pink.
Mrs. Sharman Crawford. Rosy pink.
Prince Camille de Rohan. Crimson maroon.
Paeonia. Bright crimson.
Soleil d'Or. Yellow.
Ulrich Brunner. Crimson scarlet.

Moss Roses.

Blanche Moreau. White,
Countess de Murinais. Blush white.
Crimson Globe. Crimson.
Pricess Adelaide. Pale pink.
Crested Moss. Pink. Heavily mossed.

Rugosa Roses.

Agnes Emily Carman. Crimson. Semi-double.
New Century. Pale flesh pink. Double.
Sir Thos. Lipton. White. Double.
Rosa rugosa. Crimson. Single.
Rosa rugosa alba. White. Single.

Climbing Roses.

Crimson Rambler. Crimson. Double.
Dorothy Perkins. Pale pink.
Queen Alexandra. Pale pink. Single.
May Queen. Pink. Double.
Pearl Queen. Pale pink. Double.
Wm. C. Egan. Pale pink. Double.

GLADIOLI.

Several thousand corms of these popular flowers were planted in May, which made a grand display of bloom during July, August and September.

Tests were made of several collections of named varieties, and of mixed collections of the newer unnamed hybrids now offered in dealer's catalogues. It was quite evident that there are now among the newer unnamed hybrids many types far superior to the older named varieties. These can now be obtained so cheaply that they should be grown in quantity in every amateur's garden.

Respectfully submitted,

H. L. HUTT.

PART XIV.

THE PROFESSOR OF POULTRY HUSBANDRY.

To the President of the Ontario Agricultural College.

Sir,—I have the honour to present herewith the report of the Poultry department for the year 1908.

Teaching as heretofore includes lectures to the regular College students, to Short Course students; and lectures at Poultry Shows, Poultry Institutes and Farmers' Institutes. This part of my work scarcely needs a detailed report.

During the year many improvements have been made to the department: Early in the spring the old worn out wire fences were taken down and new wire put in their places. This was badly needed as the old wire had become so worn or decayed that a bird could break it at almost any spot, hence it was practically impossible to keep the flocks separate. The new wire is much heavier and stronger than the old and should wear well.

The wooden floors of Houses Nos. 1 and 2 were taken out and cement floors put in. So far these floors have worked well and have also been successful in keeping out the rats. For a number of years we were unable to rid the houses of these pests, and they undoubtedly destroyed much grain as well as numerous small chickens. The cement floors were made with a fairly smooth finish.

The pens have been arranged somewhat differently so as to increase the number of birds per pen, and also to give a larger grain room. We can now store about five hundred bushels of feed which should enable us to buy in large quantities and save money.

The old long, narrow house, situated at the end of house No. 1 and known as the cock pens has been moved to a higher and more cheerful situation. In their old situation these pens were of little or no use to us for the reason that the building was so close to rows of evergreen trees that no sunlight could enter the pens. This house has been put upon a cement foundation about half way between the brooder house and house No. 1. The house will now be very useful to us, especially for small matings of specially selected breeders.

Not the least of the improvements has been the erection of a fine brick incubator house. This building is about 66 feet long and 40 feet wide and should give ample accommodation for all incubators that we may need for years. The interior of the building is divided into three incubator rooms of different sizes with different methods of ventilation. We have a good sized store room above the incubator rooms, of which we were greatly in need. We sincerely hope with this new building and with the aid of the Science departments of the College to successfully continue the studies in incubation that we commenced a few years ago.

Egg Production.

There can be no doubt but that egg production is one of the most profitable branches of poultry keeping, and it is therefore important that we

should devote considerable time in testing various methods of breeding, feeding, housing, etc., with a view to increasing the production per hen and also to decreasing the cost per dozen. Under this head we have to consider housing, breeding, feeding, etc.

Poultry Houses.

Four years ago there were built four styles of buildings large enough to accommodate an ordinary flock of forty or fifty birds each. These houses have been fully described in previous parts, also in Bulletin 151. The results, so far as winter egg production is concerned, has been practically the same each season; that is, the coldest or cheapest house built of single ply boards has given the best results, and the warmest, built of several thicknesses of board and paper with a four inch dead air space between the walls, has given the poorest results each winter. The houses of intermediate type have done very well; in fact, during the winter of 1907-08 they did nearly as well as the cold house. It may be of some interest to give the egg production from five White Wyandotte sisters of the same age in each of the four houses for December, January and February, 1907-8.

——	December.	January.	February.	Total.
Cold House	43	50	47	140
Warm House	....	23	21	46
Curtain Front House	15	50	50	115
House with adjustable window	2	37	31	70

The following results were obtained in the same houses from six half sisters of the Buff Orpingtons breed.

——	December.	January.	February.	Total.
Cold House	2	61	87	150
Warm House	22	46	63	131
Curtain Front House	23	34	60	117
House with adjustable window	52	58	63	173

It will be noted that the curtain front house with the Orpingtons did not do so well proportionately, but this may be accounted for by the fact that the pullets in this house were younger than those in the remaining houses; the other pullets were all hatched on the same date, May 2nd, 1907.

The Orpingtons have usually laid better than the Wyandottes in the warmest house. There was one exceptionally good laying pullet in the house with adjustable windows which brings up the record somewhat, but the fact remains that the Orpingtons in this house did best. The Wyandottes usually do as well in this house as the Orpingtons.

Each season the Wyandottes eat the grass in the runs much closer than the Orpingtons; this applies to every pen. This would indicate that Wyandottes require more green food that do Orpingtons.

Last year mention was made of tests of flocks of 50, 75 and 100. These birds are all housed in the same building and each flock has the same floor space per bird. From the results obtained from the past two winters there is not enough difference between the pens to warrant any conclusions, but

what difference there is, is slightly in favour of the flock of 50, as was the case in 1907. This year the flock of 75 did poorer than the flock of 100, which would appear to be caused by an error in feeding or selection, both of which we tried to avoid. For the test of 1908-9 we have the flocks sorted to exact ages, breeding, etc. It is, of course, too early to predict results yet as the pullets are just nicely beginning to lay; but nevertheless the egg production in the pens is very similar.

Trials of some other methods of housing, some of which are very cheap, and somewhat inconvenient, (owing to being very low down,) are being made this season.

Breeding.

Numerous are the inquiries as to which breed really does lay the best. Unfortunately I cannot see that any one breed does lay the best. There are good and bad individuals and families in all breeds. Trap-nests are now used with most breeds and we hope to have them in all the pens this winter. Birds that do not lay more than 100 eggs in ten months of any breed trap-nested are not retained as breeders, and in some varieties we make the standard 120 eggs; while in our special selected pen for the breeding of males, only females are used that have laid 200 eggs or better in 365 consecutive days. It may not be possible to produce a 200-egg strain, but one should be able to have a flock average about 150 eggs per year. The entire flock here has not done this since I have been in charge.

Below is given the egg production to date (December 4th, 1908), of eight Barred Plymouth Rock pullets hatched the 15th of March, 1908. Four of these pullets are bred from heavy laying hens and bred in line for a number of years; the remaining four pullets are bred from the common flock of Plymouth Rocks, but by no means poor hens. These pullets were all hatched in the same incubator and reared in the same colony house and brooder, and have not as yet been separated from one another, so that all conditions except parentage has been the same. The pullets began laying in August. The pullets bred from the best layers have laid 230 eggs, laying individually 74, 60, 55 and 41 eggs. The other pullets have laid 106 eggs, laying individually 38, 30, 23, and 15 eggs.

Feeds.

One cannot lay down any hard and fast rules for feeding, because the feeds available and the price of the same frequently cause changes to be made. To the laying birds, especially the pullets, we feed some wet mash and have dry mash constantly before them, just now the dry mash is composed of equal parts, by measure of bran, low grade flour and barley chop or meal; the wet mash is composed of boiled vegetables, waste bread and the same meals that are used in the dry mashes. Occasionally a little kitchen refuse, bones and meat are boiled with the vegetables. These are practically waste products and we find it makes the vegetables and meat more palatable to cook them, using the liquor to moisten the bread.

We find the kitchen waste is especially good to develop the pullets. The old stock, for dry mash, have nothing but wheat bran. The wet mashes are fed to all the stock at 3.30 each afternoon; during the winter not more than four times each week and none, or very rarely during the summer, our experience being, that at this season of the year, the birds occasionally get too fat by feeding too much wet mash, and moreover, our spare time is usually required with the growing stock.

Whole wheat is fed in deep litter each morning, a little more about noon, together with either whole mangels or clover hay,— the green food we consider very essential. Just before dark whole corn is given, all the birds will eat. During the spring and summer months but two feeds a day are given, morning and night. Then corn, unless low in price, is not used, wheat or barley taking its place. We also keep in front of the birds a hopper of beef scrap or else feed some green cut bone sometime during the day. We have difficulty getting bones in sufficient quantities that are fresh, otherwise we would feed more of them.

HATCHING.

We use both the natural and artificial methods. Bulletin 163 published early in the year gives a detailed account of our experiments. We have nothing of particular interest to add to this at present as such experiments as have been conducted since the publication of the bulletin are as yet incomplete.

REARING.

The importance of sufficient range, if possible, over new ground or at least ground that is well tilled is worthy of serious thought. We raised this season about *700 chickens in the College orchard (nearly 20 acres in* extent), and the range was none too large to grow the chickens to their best. Where the land is cultivated, or at least a portion of it, the supply of tender green food in the way of germinating weed seeds, etc., supplies ideal green food, and at the same time gives the chicks a place to scratch. The birds have not been destructive, not even to small fruits, some of which are near by; but it must be remembered that hoppers of wheat and corn, and dry mash are near each colony house, so the birds are well fed. If they were under fed or allowed to go hungry, at times, they might develop bad habits, *especially during the tomato season.*

We use a 6 x 8 colony house, and brooders or hens in the house. These houses are movable and are moved from place to place in the field or to new fields. The birds are fed about once each week and barrels of water are drawn about twice each week. The chicks are shut in every night and let out the following morning. We have found board floors necessary in the colony houses in order to keep out rats, skunks, etc. The chicks are put in the house when hatched and remain there until ready to fatten or to go into the laying houses. The laying pullets are hatched mostly during April and May and put in the laying houses about October 1st, so that they may become accustomed to their new home before the bad weather begins. *Should they show signs of laying earlier the change is made at an earlier* date.

FATTENING.

We have each year a surplus of cockerels over and above those required for breeding purposes, and the most of these are fattened and killed; a few are sold to farmers for breeders. We also fatten the cull pullets. This year from September to December we put in the fattening crates 626 birds. The loss by death among these was 2 birds. The birds weighed, (when brought in from the range, usually with full crops) 2,233 pounds. They were fed from four days to three weeks before killing.

We hoped to have fed them all three weeks but at times the demand for dressed chickens required us to kill the birds shortly after cooping.

RATIONS.

The main ration consisted of barley meal, low grade flour, middlings and buttermilk. Some other mixed grains were used and a little shredded wheat. The 626 birds ate 2,057 lbs. of ground grain and 4,000 lbs. milk.

Many farmers and others market their birds in a thin condition. We can, for the time it takes to feed, clean out the pens, etc., make at least 50 cents per hour over and above the cost of feed. We usually feed these birds by lamp light at night so little valuable time is lost.

FINANCIAL STATEMENT OF FATTENING CHICKENS.

626 chickens weighing 2,233 lbs. at 8c. per lb. live weight....	$178 64
2,057 lbs. grain at $1.50 per cwt.	30 85
4,000 lbs. buttermilk at 10c. per cwt.	4 00
Total cost	$213 49
624 dressed Chickens, bled and plucked, but undrawn, 2,358 lbs. at 12½c. per lb.	294 75
Profit	$81 26

Birds that are starved ready to kill shrink nearly 12 per cent. by bleeding and loss of feathers. We have figured frequently that the average profit per bird in three weeks' feeding was about 15 cents each, the above table shows nearly 13 cents. The profit would have been somewhat higher if all the birds had been fed at least two weeks.

FATTENING EXPERIMENT No. 1.

Nine cockerels hatched June 8th, commenced to fatten Nov. 2nd, killed Nov. 28th. Parentage—sire, Buff Orpington cockerel; dam, black mongrel hen, resembling Black Leghorn. Laid eggs averaging 2¼ ounces each.

Ration fed, by weight,—2 parts barley meal, 1 part low grade flour and 1 part bran mixed with buttermilk.

No of Legband.	Weight at Commencement.		Weight before killing, starved 14 hours.		Weight after bleeding and plucking.	
	Lbs.	Oz.	Lbs.	Ozs.	Lbs.	Ozs.
1654	4	3¼	4	13¾	4	5
1659	4	5¼	4	15	4	5
1662	3	3¾	4	10	4	0½
1666	4	13½	5	15¾	5	3¾
1676	3	13	4	14½	4	6
1677	3	10½	5	1¼	4	8½
1691	4	3¾	5	6¾	4	13
1692	4	4¾	5	12¼	5	2
1695	4	9½	6	1¾	5	7½
Totals..........	37	3¼	48	4	42	3¼

Fattening Experiment No. 2.

Six cockerels, pure bred Rhode Island Reds, hatched June 1st, commenced fattening Nov. 2nd. Killed No. 28th.

Rations as for Experiment 1.

No. of Legband.	Weight at Commencement.		Weight before killing, starved 15 hours.		Weight after bleeding and plucking.	
	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
1759	3	15	4	14¾	4	6½
1760	5	5	6	7½	5	10½
1761	4	13¼	6	1¼	5	8½
1762	4	9¼	5	13¼	5	2
1763	5	1½	6	4¼	5	8¾
1764	3	13½	5	4½	4	11½
Totals..........	27	9½	34	13½	30	15¾

In conclusion allow me to thank you for the interest you have taken in the Poultry department. My many thanks are due to the professors of various departments for assistance in many ways. I can not close without recording the faithful services of J. R. Terry.

Respectfully yours,

W. R. GRAHAM.

PART XV.

THE PROFESSOR OF FIELD HUSBANDRY AND DIRECTOR OF FIELD EXPERIMENTS.

To the President of the Ontario Agricultural College:

SIR,—I have the honour of submitting herewith, the report of the work done in the Department of Field Husbandry for the year 1908. The work along the different branches has been carried out with a good deal of satisfaction during the past year. The students have shown much interest in the lectures, in the laboratory exercises, and in the practical work in the field; the experiments at the College have furnished us with some very valuable information; and the co-operative field experiments throughout Ontario have been more extensive and more thorough than in any previous year. I believe that these different lines of activity are having a wholesome influence in the education of the people of our province, who are engaged in farming, and also in the advancement of the agriculture of Ontario.

The duties of the Department of Field Husbandry, are certainly numerous, as can be learned from a glance at the following outline of the work of the past year.

1. The delivering of lectures and the giving of demonstrations in the class room, the laboratory, and the field, before the classes in the regular College course, as outlined in the College Calendar, also before the students taking the Dairy course, the Nature Study course, and the course in Elementary Agriculture.

2. The directing of short courses in Seed Judging at the Agricultural College, Guelph, at the town of Lindsay, Victoria Co., and at the Agricultural College at Truro, Nova Scotia, and the assisting for a short time, with the work of the short course at Macdonald College, Quebec.

3. The conducting of experiments in Field Agriculture, on about 2,000 accurately measured plots at the Agricultural College.

4. The improving of the leading varieties of cereal crops, by means of systematic selection and of cross fertilization, there being about 40,000 hybrid plants grown separately in the experimental grounds in 1908.

5. The directing of co-operative experiments on 4,420 farms throughout Ontario. The results of the successfully conducted experiments will be found in the annual report of the Ontario Agricultural and Experimental Union.

6. The delivering of addresses by the writer, at various gatherings of farmers and others throughout Ontario, as follows: Eight sessions of Farmers' Institutes held at Mt. Brydges, Appin, Glencoe and Wardsville, in Middlesex county, in February; three annual meetings of Farmers' Institutes in Frontenac, Hastings, and Perth counties, in the month of June; one at the Provincial Winter Show, Guelph; one at the Eastern Winter Show, Ottawa; one at a complimentary luncheon given at the City

Hall, Guelph, in connection with the Winter Show; one at the annual meeting of the Canadian Seed Grower's Association, Ottawa; three at the Ontario Agricultural and Experimental Union, Guelph; one before the members of the Ontario Legislature; one before the members of the Toronto Branch of the Manufacturers' Association; one before the members of the Press Association, when visiting the College; one at the Union Literary Society of the College; one before the pupils of the Macdonald Consolidated School, and a number before the Farmers' Institute excursionists, who visited the College in the month of June. Besides these, the writer delivered twelve addresses at the Agricultural College of Truro, Nova Scotia, three addresses at the Macdonald College, Quebec, one address at Cornell University, Ithaca, N.Y., and one at St. Johns, Newfoundland.

7. The writing of agricultural reports and articles, including the report of the Experimental department of the College, the report of the co-operative experimental work in agriculture throughout Ontario, a bulletin on Alfalfa or Lucerne, and also the articles which are sent to the farm journals and newspapers throughout the year.

8. The carrying on of a very large correspondence with farmers, seedsmen, fertilizer manufacturers, experiment station officers, and others, throughout the entire year. At some seasons of the year the letters received number one hundred and fifty to two hundred per day.

9. The judging of grains, roots, potatoes, etc., at Agricultural exhibitions, as follows:

Fall Exhibition, Guelph; National Exhibition, Toronto; Provincial Exhibition, Truro, Nova Scotia; Spring Seed Fair, Guelph, and Autumn Seed Fair, Guelph.

10. The furnishing of plans, seeds and instructions for demonstration plots at the exhibition grounds at Simcoe, Ontario, and for experimental plots in connection with the High Schools at Lindsay, Victoria county; Perth, Lanark county; Morrisburg, Dundas county; Collingwood, Simcoe county; Galt, Waterloo county; and Essex, Essex county.

11. The fulfilling of duties required of the Secretary of the Ontario Agricultural and Experimental Union; the Vice-President of the Canadian Seed Growers' Association; the Chairman of the Committee on Breeding Cereals, of the American Plant Breeders' Association; the Secretary-Treasurer of the Macdonald Consolidated School; and a member of the Seed Committee of the Ontario Provincial Winter Fair.

I wish to publicly express my great appreciation of the excellent services rendered by the efficient and willing staff of workers in my department. Mr. John Buchanan, B.S.A., lecturer in Field Husbandry, has taken more than one-half of the lecturing in connection with the regular College course. He has also conducted all the students' examinations during the past year, with the exception of those in connection with the final examinations given to the senior class. Mr. Buchanan acted as judge in the Seed Department of the Provincial Winter Fair, and also attended several Farmers' Institute meetings in Western Ontario. Mr. W. J. Squirrell, B.S.A., has done excellent work, especially in the taking of notes in the Experimental Department, in the preparation of material for the reports, in imparting information to the farmers when visiting the College in excursion parties, in the month of June, etc. Mr. A. E. Whiteside, who has been foreman in the department for at least a dozen years, has had charge of the men and the students when at work in connection with the various experiments, and has also given excellent assistance in planning experiments and in making careful records of the same. Mr. C. R. Klinck, B.S.A., and Mr. A. W. Mason, B.S.A., have devoted nearly the whole of

their time to the work in Plant Breeding, which is now being developed to such a large extent, and from which we hope to obtain results of much importance. Miss J. I. Coxon has been not only accurate and painstaking in her duties as stenographer, but has always been very obliging and deeply interested in her work.

Outline of the Experimental Work in Field Husbandry.

About fifty acres of land, divided into upwards of 2,000 plots, are used for experiments conducted with varieties of grain, root, tuber, grass, clover, fodder, silage, and other crops; with artificial, green, and farmyard manures; with methods of cultivation, selection of seed, dates of seeding, etc. All of these experiments are conducted with the greatest care, and for several years in succession in order to secure strictly accurate results. These experiments deal with the crops grown on over nine-tenths of the cultivated land in Ontario.

The grounds have a gentle slope towards the southwest, and the soil is an average clay loam. About one-quarter of the land is manured each year with twenty tons of farmyard manure per acre; thus most of the land receives an application of farmyard manure once every four years. No commercial fertilizers are used except in distinct fertilizer experiments, and these occupy only a small number of plots each year. Within the past eleven years one green crop has been plowed under on each section of the field. The plots vary in size according to the requirements of the different experiments, and the yields per acre are determined from the actual yields of the plots in every instance.

The work in the Experimental department consists in planning the various experiments; laying out, seeding, and looking after the field plots; harvesting, threshing, weighing and testing the grain; taking up, weighing, counting, testing and storing the potatoes and roots; cutting, weighing, and harvesting the grass, corn and fodder crops, etc., and also in picking by hand the samples of grain grown on the plots, some to be sown on the plots the following year and some to be distributed for co-operative experimental work throughout Ontario. A great deal of thought and care is required in planning, supervising and examining these plots, and in studying, comparing and summarizing the results for presentation in reports, bulletins, newspaper articles, and lectures.

Results of Experiments.

All of our field experiments are conducted for at least five years before conclusions are drawn, and many of them are continued for a much longer period of time. For the results of some of the tests which were carired on for five or more years previous to 1908, the reader is referred to former reports. The results of some of the experiments which have as yet been conducted for only one or two years, are withheld until the tests can be carried through for at least another summer. As different seasons vary so much in temperature, rainfall, etc., the average results of experiments continued for several years are of much greater value than those secured from only one or two years' work. Owing to the great care exercised in the work and the number of years through which the experiments are continued, we are able to present the results with much confidence in their reliability and in their practical value. From year to year the reports of the experimental work are being more widely read and more carefully studied by the farmers of the Province, and this is leading to a greater interest in crop production and a deeper knowledge of plant life on the farms of our country.

The Conditions of the Weather in 1908.

Before considering the results of experiments with farm crops at the College for 1908, it is advisable to observe the weather conditions under which those crops were grown. The amount and the frequency of the rainfall always exert an influence on the growth and the productiveness of the crops which are under test. In each of the past nine years, careful records of the rainfall have been kept in connection with the Physical department at the College. The following table gives the total amounts of precipitation in each of the six months of the growing season in each of the past nine years, as recorded at the College.

Month.	Amount of Precipitation during the six growing months.									
	1900	1901	1902	1903	1904	1905	1906	1907	1908	Average of 9 years.
April	1.69	2.24	2.43	2.69	2.10	1.82	1.44	1.66	1.33	1.93
May	1.03	3.26	1.67	2.44	3.01	3 89	2.71	2.64	3.47	2.68
June	4.47	1.53	3.06	3.05	2.86	3 24	4.06	1.11	3.21	2.95
July	3.05	4.07	6.43	2.67	4.99	4,60	4.65	1.92	3.25	3.96
August	.87	3.51	2.18	3.47	3.88	1.98	2.13	62	2.75	2.38
September	1.52	2.45	3.58	1.48	2.80	2.85	2.49	2.87	.73	2.31
Total	12.63	17.06	19.35	15.80	19.64	18.38	17.48	10.82	14.74	16.21

It will be seen from the accompanying table that the total amount of rainfall during the six months, from April to September inclusive, was 14.7 inches, while the average total rainfall for the same months in each of the past nine years was 16.2 inches. It will also be observed that there were about 4 inches more rainfall in the summer of 1908 than in that of 1907, but about 5 inches less than in 1904 and in 1902. The amount of rainfall in May, in June, and in August was somewhat above the average of the past nine years, while that of April, July, and September was somewhat below the average of the nine years. From an examination of the Crop bulletin for Ontario, issued by the Bureau of Industries in August of the present year, we ascertain that the rainfall throughout Ontario was somewhat greater than that at the College during the months of April and May, and was rather less in the months of June and July. No records for the rainfall for August and September have yet been received for the Province. The most noticeable feature in connection with the amount of rainfall at the College during the past summer has been the comparatively small amount of rain which fell during the month of September. It was less than one-half the amount of rainfall during September of any one of the eight years previous. This light amount of rainfall during the month of September of the present year had a marked influence on some of the root crops, especially on the swede and fall turnips which thrive best when the rainfall is good and the weather is cool. During the past September, however, not only was the rainfall very light, but the weather was warm and the ravages of the plant lice on the turnips and a few of the other crops was unusually great. With the exception of the month of September, the season was a comparatively favorable one for a good growth of farm crops. The results may be considered as fairly representative of those of an average season in the Province of Ontario.

Field Agriculture in Ontario.

Ontario is a Province possessing an area about equal to the combined areas of the six New England States along with that of New York, Pennsylvania and New Jersey. It is about four times as large as England, and practically the same size as Germany and France would be combined. The Province is about one thousand miles in length, which is nearly equal to the distance from Chicago to New Orleans or from London in England, to Rome in Italy. The width of Ontario is about seven hundred and fifty miles, a distance equal to that from Guelph to South Carolina or from New York to Chicago. In round numbers, Ontario contains 126,000,000 acres, of which 40,000,000 acres are surveyed and 24,000,000 are assessed. Of the 24,284,730 acres of assessed land in Ontario, 14,107,015 acres are cleared, 5,449,125 acres are woodland, 1,963,350 acres are slashland, and 2,765,240 acres are swamp, marsh, or waste land. The areas devoted to farm crops in Ontario in 1908 arranged in order of their extent are according to the last report of the Ontario Bureau of Industries, as follows:

Pasture	3,336,169	acres	Spring Wheat	142,124	acres
Hay and Clover	3,253,141	"	Buckwheat	140,605	"
Oats	2,774,259	"	Turnips	120,920	"
Barley	734,029	"	Rye	87,908	"
Fall Wheat	679,642	"	Mangels	67,937	"
Corn	533,443	"	Beans	46,477	"
Mixed Grains	456,049	"	Sugar Beets	17,453	"
Peas	396,642	"	Carrots	4,080	"
Potatoes	166,974	"			

The young men of the Province have plenty of room for their best thoughts and their deepest study in their endeavors to become thoroughly good farmers, in the highest sense of the term. The fertility and the cultivation of the soil, the ripening and the storing of the crops, the selection and the preservation of the seed, the feeding and the care of the farm stock, the breeding of the plants and the animals, and many other problems of great value and intense interest, require not only a practical training in the operations of the farm, but also a good knowledge of the underlying principles of agriculture and exceedingly good judgment in the application of those principles to the various operations on the farm. In agriculture, nature is a co-worker with man. It is therefore essential that man know something of the laws of nature before he can expect to develop an agriculture of the highest type. Even the most common plants and animals, and the most humble operations on the farm are worthy of the best thoughts of the best men. In order to know which are the most valuable classes of crops to grow to meet the various requirements, the most desirable varieties of each class to furnish the largest amount of food of the best quality, the most suitable time and method to sow each variety to use advantageously the fertility and the moisture in the soil, etc., are all questions which every farmer should determine for himself. In this work, however, the Experimental department at the College is in a position to give a large amount of valuable assistance. As the market value of the farm crops of Ontario now amounts to $135,000,000 annually, we believe that it shows both good judgment and economy on the part of the Government to develop largely the experimental work in Field Husbandry at the College.

It is exceedingly gratifying to note that the average yield per acre of some of the principal farm crops is now increasing from year to year, owing

to the introduction of better varieties and to the improved methods of agriculture which are being adopted. There are yet exceptionally fine opportunities and almost unlimited possibilities for the agriculture of Ontario.

We can easily perceive that slight mistakes in the selection of the most suitable crops for growing in the various localities, while they may not prove disastrous, may easily result in considerable loss to the individual farmer. Sufficient thought has not been given to this phase of the question of crop production amongst our farmers. The selection of crops is necessarily governed to a large extent by the location of the farm, the quality of the soil, the particular kind of farming which is followed, etc. There are many things to be taken into consideration in the selection of those crops which are likely to give the best satisfaction.

Those classes of farm crops which have increased in area the most extensively during the past eight years are hay, pasture, oats, and barley, and those crops which have decreased in area to the greatest extent during the same period are peas, spring wheat, winter wheat and rye. It is quite probable that the decrease in the area devoted to the pea crop has been brought about largely by the ravages of the pea weevil in the southern part of the Province during recent years. As practically all of the farmers in some of the sections of Ontario, however, stopped growing peas for a few years, the trouble from the pea weevil has been greatly diminished in those sections, and the area devoted to the pea crop has been considerably increased during the past two years.

The increase in yields of grain per acre for the three principal cereals grown in Ontario for the eleven years, from 1897 to 1907 inclusive, over those for the eleven years, 1886 to 1896 inclusive, were as follows: Barley, 24.7 per cent.; oats, 16.9 per cent.; winter wheat, 12.9 per cent.; average, 18.2 per cent.

Most farmers know that oats will, as a rule, yield more bushels per acre than will barley, and that barley, in turn, is likely to yield more bushels per acre than wheat; but a bushel is a bulk measure and not weight measure, and the weight of grain produced per acre is of much greater importance than bulk. It is both interesting and instructive to compare the results of the various crops grown in Ontario under similar standards of measurement. The following table, which has been compiled from the reports of the Bureau of Industries, gives the average yields for twenty-six years in both bushels and pounds per acre of the grain crops, and of bushels and tons per acre of the root crop, as grown on the farms throughout Ontario:

Grain.	Yield per acre.	Yield per acre.
	Bushels.	Pounds.
Barley	27.7	1330
Winter Wheat	20.6	1236
Oats	35.8	1217
Peas	19.6	1176
Beans	17.1	1026
Spring Wheat	15.9	954
Buckwheat	19.6	941
Rye	16.3	913
Field Roots.		Tons.
*Mangels	462.0	13.86
Turnips	432.0	12.96
*Carrots	348.0	10.44

*Average for twenty-five instead of for twenty-six years.

It is interesting to note that the average yield of barley per acre exceeded that of oats by 113 pounds or by 9.3 per cent., and also that the average yield of mangels per acre surpassed that of turnips by 30 bushels or by practically 7 per cent.

For seven years in succession an experiment has been in progress at the College with the object of furnishing information regarding the relative productiveness of our principal grain crops, when grown under uniform conditions. In each of the six years, from 1902 to 1907 inclusive, twelve varieties of farm crops were grown in duplicate, making in all twenty-four plots in the experiment each season. In the spring of 1907, another experiment, made up of eight different classes of farm crops, was conducted in duplicate and therefore occupied sixteen plots. This experiment was repeated in 1908. The following table gives the average results of the twelve tests made during the six years, and of the four tests made in the past two years, in date of ripening, length of plants, percentage of rust, percentage of crop lodged, and of yield in tons of straw and in pounds of grain per acre.

Varieties.	Date of Ripening.	Length of Plants.	Percentage of Rust.	Percentage Lodged.	Straw per Acre.	Grain per Acre.
Average results for 6 years, 1902-7.		inches			tons.	lbs.
Emmer (Common)	Aug. 17	39	4	36	2.2	2,756
Barley (Mandscheuri)	" 4	40	5	39	1.9	2,715
Oats (Joanette)	" 14	38	7	41	2.7	2,559
Hulless Barley (Black)	" 4	31	8	40	2.0	2,527
Early Oats (Alaska)	" 7	41	10	53	2.1	2,395
Hulless Barley (White)	" 7	33	6	59	1.9	1,992
Spring Wheat (Wild Goose)	" 24	47	9	16	2.4	1,905
Spring Rye (Common)	" 14	53	4	21	2.1	1,780
Field Peas (Early Britain)	" 21	44	....	....	1.7	1,772
Flax (Common)	" 15	28	....	14	2.0	1,100
Grass Peas (Common)	Sept. 8	50	....	....	2.2	753
Vetches (Common)	" 2	34	....	....	1.6	595
Average results for 2 years, 1907-8.						
Emmer (Common)	Aug. 14	39	2	18	2.0	2,916
Barley (Mandscheuri)	" 4	33	2	6	1.8	2,761
Oats (Banner)	" 17	44	7	30	2.1	2,701
Hulless Barley (Guy Mayle)	" 3	24	6	21	1.5	2,483
Spring Wheat (Wild Goose)	" 21	46	5	1	2.5	2,311
Field Peas (Early Britain)	" 17	39	....	....	1.3	2,163
Spring Wheat (Red Fife)	" 21	45	6	16	2.2	2,011
Spring Rye (Dakota Mammoth)	" 14	50	3	3	1.9	1,769

It will be seen from the results of the two experiments presented in the accompanying table that several of the varieties have changed. Even in spite of this, however, the comparative results of the different classes of crops in the two experiments are very similar. The emmer, barley, oats, hulless barley and wild goose spring wheat are in precisely the same order in the two experiments. The comparative order of the spring rye and the field peas, are different in the two experiments. It will be observed, however, that in the first experiment the spring rye surpassed the field peas in yield per acre by an average of only 8 pounds per annum. In both experiments the oats suffered most from rust, and in both experiments the oats and the hulless barley

possessed the weakest straw. The stiffest straw in the first experiment was that of Wild Goose spring wheat and the flax, and in the second experiment that of the Wild Goose spring wheat and the Dakota Mammoth spring rye. A comparison between the result of the farm crops as grown throughout Ontario, and those grown at the Agricultural College forms a study of much interest and provides data of considerable importance. The fact that emmer has taken the lead in the production of grain in the average results of both the experiments at the College, speaks well for this new introduction into Ontario. For fuller information and for more detailed results regarding the emmer and the other classes of farm crops mentioned in the accompanying table, the reader is referred to the experiments enumerated throughout this report.

The Testing of Farm Crops Through the Medium of the Experimental Union.

Under the guidance of the Ontario Agricultural and Experimental Union, no less than 4,420 farmers throughout Ontario conducted co-operative experimental work in agriculture at their own homes in 1908. This organization is doing an admirable work in this Province. It forms a close connection between the scientific worker at the College and the practical worker on the farm. When the farmers themselves once become both interested and active in the carrying out of some important and well defined line of experimental work, they have entered upon a course of thought and action, the good results of which it is impossible to correctly estimate. This work not only enriches the lives and improves the farming operations of those actually engaged in the work, but it also tends to the betterment of agriculture generally.

Varieties of Farm Crops.

From a practical knowledge of farming operations in Ontario, and from the results already submitted in this report, it will be seen that we have a Province well suited for the cultivation of a considerable number of different classes of farm crops. While it is true that spring wheat is the great crop of Manitoba, Saskatchewan and Alberta, that corn predominates in Indiana, Illinois and Iowa, and that cotton is cultivated more extensively than any other crop in some of the Southern States, it cannot be said that Ontario is a one crop country. The conditions of soil and climate are particularly suitable for the cultivation of a number of different classes of grain, root, fodder, hay, and pasture crops. While it is of great importance for the individual farmers to study the various classes of crops to meet their own peculiar conditions and circumstances, it is also exceedingly important that they study with great care the leading varieties of each class with the object of securing those particular varieties most suitable for them to cultivate. After carefully watching the crop production of the province and closely observing the experimental work at the College for the last twenty-three years, the writer is thoroughly convinced that the selection of proper varieties is a question of great importance. Some varieties are particularly desirable, owing to the fact that they usually produce very heavy yields per acre, while others are desirable, owing to the fact that they are exceptionally early in maturing. Some varieties of grain produce very long straw and are particularly suitable for growing on land which is rather poor in quality, while other varieties naturally produce short straw and generally thrive well on

rich, mellow loams. In order to show more clearly some of the differences in varieties in regard to yield of grain per acre, we here present the average results from growing a few different kinds throughout long periods varying from thirteen to nineteen years.

Classes.	Number of years.	Varieties.	Average yield per acre.
			Bushels.
Oats	19	Joanette	87.7
		Siberian	87.3
		Egyptian	75.6
		Black Tartarian	71.8
Barley	19	Mandscheuri	71.2
		Oderbrucker	64.6
		Mensury	60.0
		New Zealand Chevalier	58.3
Winter Wheat	13	Dawson's Golden Chaff	55.4
		Imperial Amber	51 2
		Turkey Red	45.5
		Treadwell	44.8
Spring Wheat (Flour)	19	Saxonka	31.0
		Red Fife	30.7
		Colorado	27.9
Spring Wheat (Durum or macaroni)	16	Wild Goose	38.4
		Medeah	34.3
		Ontario	23.5
Potatoes	19	Empire State	225.5
		White Elephant	203.6
		Rural New Yorker No. 2	203.4
		Stray Beauty	161.5

It will be seen from the results here presented that there is a marked difference in the average results of the different varieties. As it is the policy of the Experimental department to drop the poorest varieties that they have been carefully testing for five years, it will be understood that the differences given in the table here presented are not nearly as great as many of those secured from the longer lists of varieties which have been grown for a shorter period of time. The figures here presented, however, show quite clearly that some varieties are apt to produce much more heavily than others when grown under similar conditions from year to year. For instance, there is an average annual increase in yield per acre of 15½ bushels from the Siberian over the Black Tartarian variety of oats, of 11.2 bushels from the Mandscheuri over the Mensury variety of six-rowed barley, of 10.6 bushels from the Dawson's Golden Chaff over the Treadwell variety of winter wheat, of 3.1 bushels from the Saxonka over the Colorado variety of spring wheat, of 14.9 bushels from the Wild Goose over the Ontario variety of durum wheat, and of 64 bushels from the Empire State over the Stray Beauty variety of potatoes.

It is important to know that although the different varieties of oats, barley, wheat, and potatoes have been grown in the Experimental department at the College for from thirteen to nineteen years in succession, the average yield per acre for the last few years is considerably greater than the average yield per acre for the first few years of the whole period in the case of each

of the varieties under experiment. As there was no change of seed from one farm to another during this length of time, it shows that it is quite possible to grow these crops for a considerable length of time without the introduction of fresh seed from other localities, providing proper care is exercised each year in the quality of the seed used.

Work in Plant Breeding.

For many years past we have given a good deal of attention to the improvement of our farm crops. This has involved a work, not only of endeavouring to attain a thorough knowledge of the varieties already existing in this country and in others, but also a systematic selection and the cross-fertilization of the leading varieties with the object of improving the very best which are grown at the present time. We have started a considerable number of new strains of cereals by selecting the most promising individual plants out of thousands which have been grown and examined. It is only within the last two or three years that we have been enabled to compare our selected strains started from individual plants with the regular variety work in the experimental plots at the College. In nearly all cases, we have been enabled so far to produce new strains which have given higher yields per acre than the variety from which the selections were made. This, however, has not been true in all cases, as in a few instances we have not yet secured new strains which are superior to those which we have grown previously. The following table gives the average of two and three years' results of the leading selected strains in comparison with the original variety in the case of a number of different varieties and classes of farm crops.

Class of Crop.	Variety.	Number of years.	Yield of Grain per acre (bus.)	
			Standard variety.	Selected Strain from Standard variety.
White Oats	Siberian	2	77.2	81.6
Black Oats	Joanette	2	70.2	82.0
Early Oats	Daubeney	2	84.9	87.8
Early Oats	Early Ripe	2	67.7	81.6
Sixed-rowed Barley	*Mandscheuri*	3	79.1	81.3
Two-rowed Barley	French Chevalier	3	51.8	47.9
Hulless Barley	Guy Mayle	3	40.0	40.5
Winter Wheat	Dawson's Golden Chaff	3	49.1	59.5
Winter Wheat	Bulgarian	3	37.2	38.0
Winter Wheat	Early Genesee Giant	3	42.5	44.2
Winter Wheat	Imperial Amber	3	40.7	40.6
Winter Wheat	Turkey Red	2	42.7	47.4
Spring Wheat	Red Fife	2	32.1	33.8
Durum Wheat	Wild Goose	2	29.4	28.3
Durum Wheat	Medeah	3	27.6	27.0
Millet	Siberian	2	40.2	46.9
Spring Rye	*Saatroggen*	3	30.4	33.6

The figures here presented in tabulated form show us that in nearly all cases the selected strains have given comparatively higher yields per acre than the varieties. In some cases, this increase is very marked, especially is this true in the case of Early Ripe oats, Dawson's Golden Chaff winter wheat, and Siberian millet. Some of the new types are not only heavier yielders, but are also different from the original stock in other characteristics. These differences have probably been brought about through natural cross-

fertilizations or through mutations in years past. To any one wishing to study more carefuly the influence of work carried on in selection, the writer would refer him to a book entitled "Plant Breeding," written by Hugo De Vries and printed in 1907 by the Open Court Publishing Co., Chicago.

The work in hybridization during the past year has been considerably increased. We are now beginning to see results of work conducted in former years. In 1908, we had in the Experimental Department in connection with the work in hybridization alone about 40,000 individual hybrid plants, 626 row plots, 97 plots each twenty-five links square, and 20 plots each ten links wide by one hundred links long. Some of these hybrids are showing much promise, while others are inferior. We believe that we are making fairly good progress in our endeavours to combine, through cross-fertilization, the good qualities and eliminate the undesirable characters of some of our very best varieties of cereals.

The Yields of Plants as Influenced by the Size of the Seeds Used.

The influence of the size of the seed of farm crops on the resulting crop is a question which has been discussed by practical farmers for ages past. Experimental work along this line, however, has been rather too complicated and expensive for individual farmers to carry out satisfactorily. It is more particularly a problem for the organized experiment stations to solve. As many of these stations, however, have not been established for many years, and as there are so many different questions which are forced upon the workers in these various institutions, the problem has not yet been solved in its entirety. As a step in this direction, however, some valuable work has been accomplished at our own institution in order to study one year's influence of the size of seeds on the yields of the resulting crops. In order to get as reliable results as possible, the different experiments have been repeated in each of a number of years by taking fresh seed from a general crop each spring. For the large sample, none but well developed seeds were selected; for the medium sized sample, the seeds selected were of a uniform character, plump, and of medium size; and for the small sample, none but sound, plump, and apparently good seeds of small size were used. The selections were made with great care by the use of sieves and then by hand-picking the seeds, so that the seeds of each selection would be very uniform and true to its particular selection. In the selection of large, plump grain, a sufficient quantity of each class to sow a plot twenty-five links square was carefully weighed out, after which the grains were counted. A corresponding number was then taken of the medium-sized seeds, and also of the small, plump seeds of oats, barley, spring wheat, winter wheat, and field peas. The different selections were sown upon plots of a similar size.

On making an examination of the detailed results, it was found that in forty separate tests made with seed grain of different sizes, the greatest yield of grain per acre was produced from the larger seeds in thirty-seven of the tests, from the smaller seed in two of the tests, and the yields were equal in one test.

The average results show that in every instance the largest seed produced the largest yield of grain. In no case did the smaller seed produce a greater yield of straw or a greater weight of grain per measured bushel than the seed of a larger size, but in three instances the results were similar. For a fuller statement of these results, the reader is referred to pages 86, 87, 88, and 89 of Part I. of the Annual Report of the Farmers' Institutes of the Province of Ontario for 1907.

The writer hopes to start other experiments in 1909 with the object of carrying out definite tests to ascertain the comparative value and the maximum yields produced from large numbers of seeds of different sizes, and from different thicknesses of planting. The results thus obtained would give an opportunity of comparing the maximum yields of the large and the small grains, and would also furnish other valuable information.

Continuous Selection of Seed Oats.

In 1893, an experiment was started by selecting seed from the general crop of the Joanette black oats of the previous year. The selection made in each of the following years was from the product of the selected seed of the year previous. The selections were large, plump, black seeds and light weighing and light colored seeds. The selections each year were composed of an equal number of grains, and were sown on uniform plots each twenty-five links square. Both yields per acre and the weights of grain per measured bushel are given for each of the years from 1894 to 1906 inclusive, and also for the average of each of the four year periods, which are as follows:

Years.	Weight per measured bushel (lbs.)			Yield of grain per acre (bushels).		
	Heavy plump seed.	Light seed.	Average annual difference.	Heavy plump seed.	Light seed.	Average annual difference.
1894	34.5	32.8		67.3	50.9	
1896	27.9	24.0		43.4	28.7	
1897	34.8	32.4	3.2	53.4	49.3	10.4
1898	35.9	31.3		80.1	73.7	
1899	39.1	35.1		55.2	50.3	
1900	37.4	31.0		100.2	91.4	
1901	31.1	25.1	6.0	44.4	28.5	15.8
1902	34.7	27.3		97.4	63.8	
1903	37.1	29.6		76.9	57.7	
1904	34.5	24.0		94.1	68.0	
1905	35.5	24.3	9.5	65.5	44 7	22.4
1906	31.5	23.0		62.7	39.3	

It will be seen that in every year the large, plump seed produced a greater yield and a heavier weight per measured bushel than the light seed, and that the differences between the two selections became greater as the number of years increased in which the selections were continued. The results of this experiment, later than 1906, will likely be published in future reports after they have been studied along somewhat different lines.

The Value of Sprouted Wheat for Seed Purposes.

Occasionally in Ontario the rains are so abundant at the time of harvesting the winter wheat crop that the grain becomes sprouted more or less in the shock, or even before it has been cut. As the crop dries, the germination

is checked and the grain hardens. It is often a question with farmers as to whether such grain, which has thus started to germinate, is as valuable for seed purposes as that which was cured under more favourable conditions. Rainy weather was quite general throughout Ontario during the winter wheat harvest of 1897 and again of 1902. In some parts of Ontario there was a considerable amount of rain during the winter wheat harvest of 1908, especially in the Niagara district, where the wheat ripened earlier than that grown farther north. In two different years, very careful germination tests were made at the College of wheat which was out during wet weather and which became more or less sprouted. A considerable number of varieties were used each year. The seeds were carefully counted and were planted in boxes and given an opportunity to germinate and to produce plants. For the one selection, seeds which showed no outward signs of having started to sprout were taken, and for the three other selections, seeds which had sprouted very slightly, considerably, and badly, were used. The folowing table gives the average percentage germination from each of the four selections in each of the two years:

Condition as to Sprouts.	Percentage of Germination.		
	Average First Year.	Average Second Year.	Average 2 Years.
Skin Unbroken	88	99	94
Skin Broken	66	85½	76
Considerably Sprouted	16	43½	30
Badly Sprouted	10	25½	18

It will be seen from the foregoing table that the sprouting of winter wheat in the field before it is harvested, injures the grain a great deal for seed purposes. When the grains are badly sprouted, not only do fully four-fifths of them decay in the ground, but even those which do grow produce plants which are very uneven in growth. As the results here summarized are the averages of a large number of tests, they should carry a considerable amount of weight.

Influence of Shrunken, Broken, and Immature Seed of Winter Wheat.

The results of twelve separate tests made at the College show an average increase in yield of grain per acre of 7.8 bushels from plump, as compared with shrunken seed, and of 35.6 bushels from sound as compared with broken seed. Seed which was allowed to become thoroughly ripened before it was cut, produced a greater yield of both grain and straw and a heavier weight of grain per measured bushel than that produced by wheat which was cut at any one of four earlier stages of maturity.

Influence of Shrunken and Broken Seed of Spring Grains.

In the average of six years' experiments which we have conducted, we have obtained an average increase in yield of grain per acre of 7.8 bushels from plump as compared with shrunken barley, and of 5 bushels from plump

as compared with shrunken spring wheat. In comparing sound grain with that which had been broken by the separator in threshing, the average yield obtained from the former surpassed that obtained from the latter by 10.6 bushels per acre in the experiments with barley for six years, and of 19 bushels per acre in the average of the experiments with peas for nine years. In these experiments, equal numbers of whole seeds and double the number of broken or half seeds were used. In all cases, the seeds were counted with great accuracy and were sown in plots twenty-five links square.

Treatment of Grain for Smut.

In order to study the result from treating seed oats and seed wheat for the prevention of smut, experiments have been conducted at the College for several years in succession. In each of five different years, two varieties of oats have received seven different treatments, and two varieties of winter wheat have received five different treatments. The various treatments used were as follows:

(1) *Immersion in Diluted Formalin.* The solution of formalin used for the immersion process was made by pouring one-half pint of the formalin into 21 gallons of water, and the seed oats were immersed in the solution for twenty minutes.

(2) *Sprinkling with Diluted Formalin.* One-half pint of formalin was poured into 5 gallons of water. The oats were then sprinkled with this solution and carefully stirred until the grain was thoroughly moistened.

(3) *Immersion in Hot Water.* For this treatment, the grain was placed in a bag, which was then immersed in water at about 115 degrees F. Soon afterwards it was placed in water which was kept at a temperature of between 130 degrees and 135 degrees F. The grain was occasionally stirred, and was allowed to remain in the water for a period of fifteen minutes. It was then spread out on a clean floor to dry, where it was stirred occasionally.

(4) *Immersion in Bluestone Solution for Twelve Hours.* In this treatment, the bluestone solution was made by dissolving one pound of bluestone in 25 gallons of water, and the oats were immersed in this solution for a period of twelve hours.

(5) *Immersion in Bluestone Solution for Five Minutes.* For this treatment, a strong solution was made by dissolving one pound of copper sulphate (bluestone) in one gallon of water, and then immersing the oats in the solution for a period of five minutes.

(6) *Immersion in Potassium Sulphide Solution.* The potassium sulphide treatment consisted of soaking the seed for two hours in a solution made by dissolving eight pounds of potassium sulphide in 50 gallons of water.

(7) *Sprinkling with Bluestone Solution.* This solution was made by disolving one pound of bluestone in 10 gallons of water, which was used for sprinkling over the oats until they were thoroughly moistened after being carefully stirred.

(8) *Untreated.* One sample of oats of each variety was left untreated in order that the influence of the various treatments might be observed.

After the treatments had been made for a few hours, the grains were carefully sown on separate plots, each of which was exactly twenty-five links long by twenty-five links wide. When the winter wheat was about ready to cut, it was carefully examined and the smutted heads were picked out and shelled. The rest of the crop was then threshed and again examined for

the smut balls. When the oats were coming into head, they were examined frequently and all smutted heads removed and carefully counted. The following table gives the average results in percentage of smutted grains of winter wheat, and of smutted heads of oats for five years during which each experiment was conducted.

TREATMENT.	Per cent. of Smut in Oats. Average of 5 Years.	Per cent. of Stinking Smut in Wheat. Average of 5 Years.
Immersion in Diluted formalin	.0	.0
Sprinkling with diluted formalin	.0	.0
Immersion in hot water	.0	.0
Immersion in bluestone solution for 12 hours	.1	.0
Immersion in bluestone solution for 5 minutes	.8	....
Immersion in potassium sulphide solution	1.2	....
Sprinkling with bluestone solution	1.3	.1
Untreated	5.7	4.2

In 1908, the winter wheat which was not treated had 6.8 per cent. of smut. That was the largest percentage of smut in any one year with the exception of 1905, when the untreated seed produced a crop of which over 9 per cent. was smut. Not only does the stinking smut in wheat reduce the yield per acre, but it greatly lessens the value of the wheat for flour production. The foregoing table shows that several treatments have been quite successful in preventing the development of stinking smut in wheat and of loose smut in oats, but some of them have proven to be slightly injurious to the seed to which they are applied. The results of all the experiments, however, show that the greatest yield of both winter wheat and oats per acre were produced from immersing seed in a solution made by adding one pint of formalin to 42 gallons of water, in which the grain was immersed for a period of twenty minutes. The treatment was easily applied, comparatively cheap, effectual in killing the smut spores, and also effectual in producing the largest average yield of both wheat and oats per acre of all the treatments used.

Differences in the Susceptibility of Varieties of Oats to Attacks of Smut.

It has been known for years past that oats could be successfully treated so as to kill the smut spores, and thus enable the seed to produce a greater yield of grain per acre. It has not been so clearly understood, however, that there was a marked variation in the different varieties of oats regarding the susceptibility to the attacks of smut. It seems quite evident from our experimental work at Guelph that varieties of both winter wheat and oats do not offer equal conditons for the growth and development of the smut. Some varieties certainly appear to be decidedly more susceptible than others to the attacks of this parasitic growth. During the years 1902, 1903, 1904, and 1905, we did not treat our varieties of oats for smut, but carefully picked out all smutted heads each year and kept an accurate record of the amounts of smut produced in the different varieties. In the spring of 1906, however, the varieties were all carefully treated by immersing the seed for twenty minutes in a solution made from one-half pint of formalin and 21

gallons of water. Since that time, the same varieties have not been again treated. The following table gives the number of smutted heads taken from a plot 10 links wide by 100 links long, from each of six different varieties of oats in each of the past seven years.

Variety.	Before Treatment.				After Treatment.		
	1902	1903	1904	1905	1906	1907	1908
Early Ripe..............	0	0	3	0	0	0	0
Joanette....	20	9	10	18	0	2	12
Siberian...............	32	43	78	20	0	1	0
American Banner	116	303	317	22	0	3	2
Black Tartarian.........	332	608	369	62	0	3	12
Early Champion........	634	380	1244	166	0	11	9

The results are certainly interesting and very suggestive. They show a wonderful difference in the comparative amount of smut produced by the different varieties of oats. They also show that the treatment in 1906 was very effectual in preventing the growth of smut in that year. It will also be seen that without further treatment the smut is again gradually increasing, but in the third year, after treatment, the smut is very much less than in any year before the treatment took place.

Another point which is brought out in the results presented, is the fact that the amount of smut varies considerably with the different seasons. It will be noticed that there was a greater amount of smut in 1904 than in either of the years 1903 or 1905.

The Early Ripe variety is the earliest oat amongst some two hundred and fifty varieties which we have grown in the experimental grounds, but the grain is long and slender, giving a light weight per measured bushel. It is quite probable, however, that this variety is entirely immune to the attacks of smut. It is true that there were three smut heads found in 1904, but when it is considered that fully 17,000 grains of oats are sown in each plot, it is quite likely that the three smutted heads were all from one plant, produced from a seed of some other variety, which, by means of manure, or in some other way, got into the plot. Taking advantage of the early maturity and of the apparent immunity to the attacks of smut, we have been using the Early Ripe variety to cross with the American Banner with the hope of securing a hybrid which will be early in maturing, immune to the attacks of smut, and at the same time will produce a large yield of grain of good quality. We have already a large number of hybrids produced from these two parents which are indeed interesting, and which are at present being very carefully studied and tested.

Quantity of Flax Seed per Acre.

For four years in succession, each of four varieties of Flax has been sown, at the rate of one peck, two pecks, three pecks, eight pecks, twelve pecks,

and sixteen pecks per acre, making in all, twenty-four plots in the experiment each year. The following table gives the average results of this experiment, for a period of four years:

Amount of Seed Sown.	Weight per Measured Bushel.	Yield of Straw Per Acre.	Yield of Grain Per Acre.	Yield of Grain Per Acre less amount of Seed Sown.
	lbs.	tons.	bus.	bus.
1 Peck per Acre	54.9	1.38	15.0	14.8
2 Pecks " "	54.7	1.59	15.9	15.4
3 " " "	54.8	1.86	17.5	16.7
8 " " "	54.7	2.13	18.1	16.1
12 " " "	54.4	2.26	17.9	14.9
16 " " "	54.2	2.23	16.0	12.0

The highest average yield of Flax seed per acre was produced from eight pecks or two bushels of seed per acre. It will be seen, however, that the greatest yield of Flax seed, less the amount of seed used, was obtained by sowing three pecks of the seed per acre. It is generally understood that when seed production is the only object in view, a much thinner seeding is desirable than when the crop is intended for the production of fibre. Therefore when this experiment was commenced, it was expected that one of the first three seedings mentioned above would probably indicate the best quality of seed to sow per acre, for the production of seed, and that one of the largest seedings would give a similar indication regarding the sowing of Flax for fibre production. When Flax is sown quite thickly, the stems grow slender and upright, and do not branch, with the result that a much longer and better quality of fibre is produced, than when thinner sowing is resorted to. There was a marked difference in production, from the different varieties, as will be seen under the discussion of the varieties of Flax in another part of this report.

Seed Mixtures for Grain Production.

According to the Report of the Bureau of Industries for the Province of Ontario, we learn that there were 456,049 acres of mixed grains grown in 1908. Those counties having the greatest number of acres in mixed grains during the past season were as follows: Wellington, 41,437 acres; Huron, 24,756 acres; Waterloo, 22,044 acres; Simcoe, 20,590 acres; Ontario, 19,621 acres; and Grey, 19,275 acres. It will therefore be seen that mixed grains are grown quite extensively throughout Ontario.

Within the past nineteen years, a large amount of experimental work has been carried on at the College with the endeavor to glean reliable information regarding the different values of grain mixtures in comparison with the growing of the same grains separately, for the production of both grain and straw. Most of these experiments have been conducted for several years in succession, and the results which have already been obtained have exerted a considerable amount of influence throughout Ontario, in a general sowing of certain grains in definite proportions.

For five years in succession, an experiment was conducted in growing oats, barley, spring wheat, and peas separately and in eleven different combinations, having two, three, or four grains in each mixture. The results show that the grain which was sown in mixtures produced larger yields

per acre than the same kinds of grain sown separately, in from ninety to ninety-five per cent. of the tests. Of the eleven distinct mixtures used, the combination of oats and barley gave the highest average yield of threshed grain per acre. This mixture also gave a decidedly larger yield than any of the grains grown separately.

In 1902 and in each of the four years following, an experiment was conducted in duplicate in order to ascertain whether a seed mixture, composed of one bushel of oats and one and one-half bushels of barley per acre, could be improved by the addition of a small quantity of some other kind of seed. In addition to the mixture of oats and barley here mentioned, one-half bushel of flax, emmer, spring wheat and hulless barley were added, making in all five different combinations. The average results of the ten tests made in the five years showed that the greatest yield of grain per acre was produced by the use of oats and barley without the addition of any other kind of grain as included in this experiment.

Nine Mixtures of Barley and Oats Grown Together.

For six years in succession, an experiment was conducted at the College by using nine different porportions of oats and barley in order to determine which mixture and which quantity of seed would give the best results in the production of grain and straw. The lightest seeding used consisted of one-half bushel of oats and one-half bushel of barley, and the heaviest seeding of one and one-half bushels of oats and one and one-half bushels of barley per acre. The experiment was started in 1899 and finished in 1904. The average results show that the greatest number of pounds of grain per acre was produced from a mixture of one bushel of oats (34 lbs.) and one bushel of barley (48 lbs.), or a total amount of 82 pounds of mixed seed per acre.

In the spring of 1907, another experiment was started. This consisted in testing nine different proportions of oats and barley. A mixture of four pecks of oats and four pecks of barley, by weight per acre, was the only mixture which was similar in the two experiments. The experiment was conducted twice in 1907, first by using the Mandscheuri barley and the Daubeney oats, and second by using the Chevalier barley and the Siberian oats. In 1908, an experiment was conducted the same as in 1907, with the exception that the Two-rowed Canadian barley was used instead of the Chevalier barley in combination with the Siberian oats. The average results of the duplicate experiment for the two years are as follows:

MIXTURES. *Quantities of Seed, per acre by weight.*	Tons of Straw per acre.		Lbs. of Grain per acre.	
	1908	Average 2 Years 1907-08	1908	Average 2 Years 1907-08
3 pecks Oats, 3 pecks Barley	1.99	1.61	3114	2396
3 " " 4 " "	2.01	1.66	3077	2420
3 " " 5 " "	1.96	1.65	3162	2537
4 " " 3 " "	2.14	1.70	3136	2463
4 " " 4 " "	1.95	1.64	3153	2566
4 " " 5 " "	2.01	1.62	3207	2529
5 " " 3 " "	2.11	1.69	3288	2515
5 " " 4 " "	2.00	1.55	3333	2499
5 " " 5 " "	2.16	1.61	3294	2472

The highest yield of grain per acre was produced from the mixture of four pecks of oats and four pecks of barley in 1907, and from five pecks of oats and four pecks of barley in 1908. In the average of the two years, however, the greatest yield was produced from four pecks or 34 lbs. of oats, and four pecks or 48 lbs. of barley per acre. This is the identical combination which gave the highest yield of grain in a former experiment of a somewhat similar character, which was conducted in duplicate in each of six years. Another interesting feature of the experiment is the fact that both the lightest and the heaviest seedings gave comparatively low results in average yield of grain per acre.

The selection of varieties which will mature at about the same time is exceedingly important when it is desired to grow the grains in combination. A medium ripening variety of oats and a medium ripening variety of barley do not, as a rule, mix well together, owing to the fact that barley generally ripens several days earlier than oats. For this purpose, a very early variety of oats should be used with a six-rowed barley, such as, the Mandscheuri, or a very late variety of barley should be used with an ordinary maturing variety of oats, such as the Banner. In order to test the comparative values of leading varieties of oats and of barleys when grown in combination, an extensive experiment was conducted in 1907 and was repeated in duplicate in 1908. The following table gives the average results in yield of both straw and grain per acre for the two years:

MIXTURES. Quantities of seed per acre by weight.	Tons. of straw per acre. 1908	Tons. of straw per acre. Average 2 years 1907-08.	Lbs. of grain per acre. 1908	Lbs. of grain per acre. Average 2 years 1907-08.
Black Hulless Barley, 60 lbs., Common Emmer 40 lbs	1.77	1.43	2695	2267
Guy Mayle Hulless Barley, 60 lbs., Siberian Oats, 34 lbs	1.71	1.67	2924	2614
Black Hulless Barley, 60 lbs., Siberian Oats, 34 lbs	1.92	1.60	2922	2389
Two-rowed Canadian Barley, 48 lbs., Banner Oats, 34 lbs	2.02	1.80	2801	2566
Two-rowed Canadian Barley, 48 lbs., Siberian Oats, 34 lbs	1.87	1.70	2663	2517
French Chevalier Barley, 48 lbs., Siberian Oats, 34 lbs	2.44	2.12	2819	2731
Mandscheuri Barley, 48 lbs., Daubeney Oats, 34 lbs	1.92	1.63	3278	2985
Mandscheuri Barley, 48 lbs., Alaska Oats, 34 lbs	1.93	1.77	3151	3021
Mandscheuri Barley, 48 lbs., Siberian Oats. 34 lbs	1.79	1.54	2937	2430
Mandscheuri Barley, 48 lbs., Banner Oats, 34 lbs	1.97	1.80	3149	2833
Mandscheuri Barley, 48 lbs., Joanette Oats, 34 lbs	2.03	1.82	2813	2725
Mandscheuri Barley, 48 lbs., Black Hulless Barley, 60 lbs	1.97	1.58	3321	2866
Mandscheuri Barley, 48 lbs., Guy Mayle Hulless Barley, 60 lbs	2.02	1.70	3338	2986
Mandscheuri Barley, 48 lbs., Dakota Mammoth Rye, 56 lbs	2.05	1.73	2909	2392
Mandscheuri Barley, 48 lbs., Common Emmer, 40 lbs	1.86	1.62	3290	2813
Mandscheuri Barley, 48 lbs., Wild Goose Spring Wheat, 60 lbs	2.12	1.73	2987	2561
Mandscheuri Barley, 48 lbs., Early Britain Peas, 60 lbs	1.77	1.53	2997	2755
Mandscheuri Barley, 48 lbs., Prussian Blue Peas, 60 lbs	2.00	1.70	2540	2324
Mandscheuri Barley, 48 lbs., Flax, 56 lbs	1.63	1.61	3364	3242

As a result of two years' experiments in testing nineteen different mixtures, it will be seen that the greatest average yield of grain per acre was produced by the Mandscheuri barley with a very early variety of oats, such as the Alaska or the Daubeney. The Mandscheuri barley and the Guy Mayle Hulless barley also gave a high yield of grain per acre. The Alaska and Daubeney varieties of early oats have been close rivals in their production of grain per acre when grown separately. Generally speaking, however, the Daubeney has surpassed the Alaska variety.

The percentage of each kind of grain produced from each variety in he various mixtures was carefully determined in the crop of the past year. 'he results show that barley in nearly all cases produces more than half of he crop. When one bushel by measure of each of the Mandscheuri barley nd the Banner oats are sown together, the crop produced is about two-thirds :s weight in barley and one-third in oats. In the case of the Two-rowed !anadian barley and the Siberian oats, the percentage of the two grains in he resulting crop is about equal. When Mandscheuri barley is mixed with he Prussian Blue peas, we find 88 per cent, of the former and only 12 per ent. of the latter in the crop produced. When Mandscheuri barley and .ax are used in a combination, there is only 11 1/3 per cent. of the flax in he new crop. In no mixture did any kind of grain give as high a percentge in the crop produced as the Mandscheuri barley. After this experiment ; conducted over a longer period, we hope to present more detailed results long the line of the percentages of the different kinds of grain in the crop hen threshed.

Eight Kinds of Grain Grown in Combination.

For two years in succession, an experiment has been under way in which ight kinds of grain have been used in different combinations. One of the rincipal objects of this experiment has been to learn which of the eight inds of grain will produce the greatest percentage of both straw and grain 1 the crop produced. The mixtures have been made up in two different rays: First, by using the same amount of seed of each variety as is usually own when the grains are grown separately; and second, by using equal uantities of seed of all the varieties. Each of the mixtures here described vas sown at the rate of 112 pounds of seed per acre. Both parts of the xperiment were conducted in duplicate each year. The following table ;ives the average results of two tests in each of two years and shows the ercentage of each grain in the crop produced from each of the methods f combination indicated above:

Varieties used in each mixture.	Percentage of Grains in Mixtures. Uniform weights of seed sown 2 yrs. 4 tests.			Quantities of seed in same proportion as when grown separately. 2 yrs. 4 tests.			Average of two classes of mixtures 2 yrs. 8 tests.
	1907	1908	Average	1907	1908	Average	Average of two averages.
ix-rowed Barley (Mandscheuri)...	24.4	30.4	27.4	23.8	27.5	25.7	26.6
ats (Banner)........	15.8	21.3	18.5	11.5	13.6	12.5	15.5
pring Wheat (Red Fife)........	17.3	7.7	12.5	16.5	8 8	12.6	12.5
mmer (Common)........	12.8	7.9	10.3	14.8	10.6	12.7	11.5
pring Rye (Dakota Mammoth)....	10.6	9.5	10.1	9.8	8.1	9.0	9.6
pring Wheat (Wild Goose)........	9.9	6.7	8.3	11.3	9.4	10.3	9.3
lulless Barley (Guy Mayle)........	4.9	10.6	7.7	5.3	11.4	8.3	8.0
ield Peas (Early Britain)........	4.5	5.9	5.2	7.3	10.6	8.9	7.0

It will be seen from both of these tests made in each of two years, that he Mandscheuri six-rowed barley, when mixed along with seven other inds of grain, gave decidedly the largest percentage of the resulting crop. n fact, the average results show that the percentage of barley in the crop

produced was almost double that of any other kind of grain in the mixture. This certainly speaks well for the Mandscheuri barley in holding its own with all other competitors. It is a very heavy yielding variety whether sown in combination with other grains or when sown by itself.

It is interesting to compare these results with those of another experiment which was started in 1902 and conducted for six years in succession, in which twelve different kinds of grains were used in the manner described in the former experiment. The average results of the former experiment for the six years are as follows:

Varieties used in each mixture.	Percentage of grains in mixtures. Uniform weights of seed sown. 6 yrs. 12 tests.	Percentage of grains in mixtures. Quantities of seed in same proportion as when grown separately. 6 yrs. 12 tests.
Six-rowed Barley (Mandscheuri)	18.1	17.1
Spring Rye (Common)	13.3	14.1
Hulless Barley (Black)	12.5	14.2
Early White Oats (Alaska)	12.7	9.4
Black Oats (Joanette)	11.9	8.6
Emmer (Common)	7.0	7.9
Hulless Barley (White)	5.8	6.9
Peas (Field)	4.4	7.6
Spring Wheat (Wild Goose)	4.8	6.3
Grass Peas	5.6	4.7
Vetches (Common)	2.3	1.9
Flax (Common)	1.8	1.3

From an examination of the two tables, it will be seen that the Mandscheuri barley has given the highest percentage of grain in the crops grown from the different mixtures in every instance. The Banner oats have given higher percentages of grain, comparatively speaking, than either the Alaska or the Joanette varieties. The position of both the Spring Rye and the Hulless Barley varies somewhat in the two experiments. Emmer occupies a comparatively uniform position throughout, the average percentage of grain in comparison with the other classes being about the same in the ripened crop as it occupied in the seed before it was sown. All of these experiments go to confirm the results of other experiments and to show that it is difficult to make a mixture which will produce a heavier yield of grain per acre than one made by a combination of barley and oats.

DIFFERENT VARIETIES OF THE SAME CLASS OF GRAIN GROWN IN COMBINATION.

We have grown different varieties of winter wheat, of oats, and of barley separately and in combination, with the object of ascertaining whether or not there was any advantage in growing mixtures as against growing the varieties separately. The results of experiments conducted with winter wheat for five years and of barley and oats each for two years show that the mixtures have given very similar results to the averages of the varieties when grown separately. The results of our experimental work up to date, therefore, seem to strongly indicate that there may be a decided advantage from growing different classes of cereals together, but that there is no marked advantage by growing different varieties of the same class in combination.

VARIETIES OF SIX-ROWED, TWO-ROWED AND HULLESS BARLEY.

During the past few years, the area devoted to the barley crop in Ontario as been increased by about twenty-five thousand acres annually. There is o grain crop in Ontario regarding which the area has increased so rapidly uring the past eight or ten years as the barley crop. Not only has the area een greatly increased, but we find that the yield of threshed grain per acre as increased about twenty-five per cent. during the past ten years, as comared with the ten years previous. Although the two-rowed barleys are grown very extensively in England, in Germany, and in other European ountries, the six-rowed varieties are used almost entirely in Ontario. They ive a very large yield of grain per acre, as will be seen from the results resented in this and in other reports. A large number of different varieties btained from various countries have been carefully tested in our experinental grounds. Practically all varieties are grown for at least five years n succession, after which period those kinds which produce poor results are liscarded, and those which make satisfactory returns are retained for uture experimental work. In this way the list is gradually changing by ome of the varieties being dropped from the tests, while new varieties are dded from time to time. There are but very few varieties in America which we have not had in our comparative tests.

Class and Varieties.	Bearded or Beardless.	Color of Grain.	Average Height (ins.)	Per cent of Rust.	Days to reach maturity.	Weight per measured bus. (lbs.)	Yield per acre. Straw (tons).	Yield per acre. Grain (bus.)
Six-rowed.								
Mandscheuri	Be.	White	39	3	105	51.2	2.21	74.7
California Brewing	Be.	White	33	8	105	46.3	2.08	73.3
Bonanza	Be.	White	40	2	105	51.3	1.71	68.4
Triumph	Be.	White	40	3	105	51.4	1.99	67.7
Oderbrucker	Be.	White	38	3	105	51.0	1.99	67.3
Common Six-rowed	Be.	White	38	3	104	52.0	1.93	65.6
Scotch Improved	Be.	White	36	3	106	51.4	1.93	63.1
Mensury	Be.	White	36	3	105	51.9	1.97	61.2
Black French	Be.	Black	32	7	103	49 8	1.54	58.8
Imperial Six rowed	Be.	White	36	3	104	52.1	1.82	57.0
Ohio Beardless	Ba.	White	39	3	102	46.1	1.88	49.9
Zero	Be.	White	38	5	118	50.6	2 74	49.8
Success	Ba.	White	36	2	97	47.4	1.57	48.7
Champion Beardless	Ba.	White	36	2	97	47.6	1.59	48.6
Dakota Silver Beardless	Ba.	White	38	3	101	46.2	1.82	48.1
Humboldt	Ba.	White	36	2	97	47.4	1.52	46.3
Two-rowed.								
Imported, No. 5591, Iowa	Be.	White	33	3	110	52.4	2.04	63.5
Hanna, No. 5590, Iowa	Be.	White	33	4	108	53.9	1.79	62.2
Jarman's Selected Beardless	Be.	White	34	4	108	53.4	2.10	61.0
Hanna Gerste	Be.	White	33	4	108	53.3	1 88	60.0
Two-rowed Canadian	Be.	White	36	5	110	53.1	2.13	55.6
New Zealand Chevalier	Be.	White	34	5	111	51.1	2.25	53.8
New Awnless	Be.	White	33	4	112	51.7	2.26	52.9
French Chevalier	Be.	White	33	4	111	51.2	2.14	52.6
Selected Canadian Thorpe	Be.	White	37	6	109	52.9	2.00	52.6
Duckbill	Be.	White	37	5	110	51.9	2.14	52.1
Hulless.								
Guy Mayle	Be.	Green	27	4	99	61.0	1.61	44.2
Purple	Be.	Purp'l	29	5	100	63.7	1.68	43.0
Black Hulless	Be.	Black	29	4	100	62.8	1.74	40.5
Hog	Be.	White	27	3	101	61.0	1.74	40.4
Winnipeg No. 2	Be.	White	27	3	102	60.5	1.71	40.3
Hungarian	Be.	White	82	4	105	59.6	1.63	38.7
New White Hulless	Ba.	White	31	6	106	59.9	1.87	31.4

The table gives the results of each of sixteen varieties of six-rowed barley, ten varieties of two-rowed barley, and seven varieties of hulless barley which have been grown in the experimental plots during the past five years:

The Mandscheuri variety of six-rowed barley, which we have already reported as giving such excellent results when grown in combination with oats, also stands at the head of the list of all the varieties of barley which have been tested at the College for each of the past five years. Although it is followed by the California Brewing by a difference of less than two bushels per acre, the last named variety is short in its growth, comparatively weak in the straw and possesses grain which is of a coarse character, and awns or beards which are exceedingly stiff. The Mandscheuri barley, however, is a variety having grain that is of excellent quality. The plants grow to a good height, the heads are of good size and well formed, the grain weighs well per measured bushel, and there is nearly always a very excellent yield of both grain and straw. It is interesting to compare the results of some of the lighter yielding varieties with that of the Mandscheuri. It will be seen that this variety surpasses the Common Six-rowed by fully 9 bushels per acre. This difference in yield applied to all the barley land in Ontario in 1908 would make an increase of over six million bushels of barley in the Province in the one year, an amount sufficient to maintain about twenty-five agricultural colleges similar to the one at Guelph.

It will be observed that each of the two-rowed barleys has produced grain which weighs on an average of over 51 pounds per measured bushel, the highest being the Hanna which weighs almost 54 pounds per measured bushel, or about six pounds above the standard weight of barley for Ontario. It was formerly thought that the two-rowed barleys produced rather longer straw than the six-rowed barleys. In the results here given, however, it will be seen that a number of the six-rowed barleys produced a greater length of straw than any of those having the two rows.

The hulless barleys are rather characteristic as possessing comparatively short straw, and having grain which has a standard weight of 60 pounds per measured bushel. The standard bushel of the hulless barley therefore weighs twelve pounds more than the standard weight for either the six-rowed or the two-rowed varieties. The Guy Mayle, which stands at the head of the list amongst the hulless barleys, is one that has made an excellent record in connection with the co-operative work throughout Ontario. In 1908, it gave a little over six bushels per acre more than the Black Hulless variety in the average of ten different experiments conducted in different parts of the Province. The Black Hulless is probably the best known of this class of barleys in Ontario. Not only does it give a less yield of grain per acre than the Guy Mayle variety, but it seems to be rather weaker in the straw, when grown in comparison with the former variety. It will be noticed that there are both six-rowed and hulless barleys which are black in the grain, and both six-rowed and hulless varieties which are beardless in the head. It will also be noticed that in every case the beardless barley has produced comparatively low results in yield of grain per acre.

Varieties of Winter Barley.

Although winter barley is scarcely known in the regular agriculture of Ontario, we have been doing something in testing a few varieties at the College for a number of years past. One variety we have grown for twelve years, and the average results for the twelve years are as follows: Weight, per measured bushel, 47.1 lbs.; yield of straw per acre, 1.2 tons; and yield

of grain per acre, 54 bushels. We have found by continually growing winter barley without change of seed that we have been enabled to increase the yield per acre about six bushels, as compared with imported seed in the average of experiments conducted for five years. In 1908, and also in 1907, the Tennessee variety of winter barley gave us decidedly the largest yield of grain per acre. Within the past fifteen years, the winter barley has been completely killed out on three occasions. It appears to be somewhat more tender than winter wheat, but when it survives the winter it usually gives very high yields of grain per acre.

Varieties of Oats.

The oat crop is the most important of all the cereal crops grown in Ontario at the present time. The area devoted to this crop reached 2,774,-259 acres, according to the latest report of the Bureau of Industries for the Province. This area is reported as yielding over ninety-six million bushels of grain.

As three hundred varieties of oats have been carefully tested at the Agricultural College, an opportunity has been afforded to ascertain something as to the productiveness and the characteristics of the various kinds of oats when grown under similar conditions. As over two hundred and fifty of these varieties have been grown in the Experimental department in each of five years or more, the records are very valuable. As sixty-one of these varieties have been under test during each of the past five years, the summary results are here presented as a basis of comparison and as a reference of varieties.

In the results of oats given in 1907, the Yellow Russian stood first and the Vick's American Banner second. With the yields of 1903 dropped off and those for 1908 included, the results of these two varieties have been slightly changed, and now we find the Vick's American Banner standing at the top of the list in yield of grain per acre. Those varieties which have produced an average yield of more than ninety bushels per acre are the Banner, the New Zealand, the Yellow Russian, and the Peerless. The yield of straw of the Scarboro variety of oats has been particularly high in each of the five years, the average for the whole period being 3.27 tons. This is the only variety which gave an average yield of straw of more than three tons per acre, although the American Banner very nearly reached that quantity. In weight per measured bushel, thirty-three of the varieties have gone beyond the standard weight for oats in Ontario. The heaviest weight per measured bushel of all the varieties grown at the College for the five year period was that produced by the Early Dawson, the weight being 38.4 pounds. The Daubeney variety of oats, which is one of the very best kinds of very early oats which we have grown at the College, has produced an average of a little over 88 bushels of grain per acre. The Daubeney produces a white grain which is of very good quality indeed, being quite thin in the hull. The Yellow Russian, which has made a very high stand in yield of grain per acre, was distributed throughout Ontario in the Spring of 1908 for co-operative experiments throughout the Province. In the average results of the experiments conducted on one hundred and fifteen farms throughout Ontario during the past year, the Yellow Russian gave an average of 46.4, the Irish Victor of 45, and the Daubeney of 43.1 bushels per acre. The Yellow Russian produced the largest amount of straw and was the most popular of these varieties amongst the experimenters. The Siberian is a variety of oats which has made a very good record at the College in past years, and has done very well indeed in many localities.

Varieties of Oats.	Average results for 5 years.						Yield per acre. Bushels of Grain.	
	Heads mane or spreading.	Days to mature.	Height (ins.)	Per cent. rust.	Weight per measured bushel (lbs.)	Tons of straw per acre.	1908.	Average 5 years.
Vick's American Banner	Spreading.	111	50	14	33.9	2.95	83.5	93.8
New Zealand	"	111	49	12	32.2	2.59	85.5	93.3
Yellow Russian	"	111	48	11	32.5	2.66	79.1	92.9
Peerless	"	111	50	13	33.3	2.72	89.6	92.5
Irish Victor	"	111	50	14	33.6	2.36	83.4	89.2
Liberty	"	111	50	12	32.7	2.71	88.1	89.1
Daubeney	"	102	42	7	34.2	2.02	89.0	88.3
Siberian	"	108	48	12	33.2	2.36	82.7	88.0
Ertragreichster	"	112	48	12	32.8	2.50	78.8	87.7
Michigan Wonder	"	111	49	15	33.4	2.47	76.8	87.6
German Rust Proof	"	111	50	13	33.0	2.68	76.7	87.3
Imported No. 534 Iowa	"	108	46	9	33.9	2.27	78.1	86.9
New Golden Cluster	"	111	46	12	31.2	2.28	73.5	86.7
Waterloo	"	111	49	12	34.1	2.39	79.4	85.9
University No. 6	"	110	49	12	34.2	2.36	71.8	85.5
National	"	111	48	14	34.2	2.38	70.8	85.3
Newmarket	"	108	48	12	35.1	2.38	65.3	85.0
Alaska	"	101	44	6	34.5	1.96	74.7	84.7
Imported No. 545 Iowa	"	108	45	9	34.3	2.15	70.8	84.5
Ligowa Hafer	"	109	47	13	35.4	2.43	70.6	84.5
Oderbrucker	"	111	48	12	34.5	2.44	85.8	84.1
Prince Royal	"	109	47	16	34.3	2.22	73.9	83.4
Canadian Pride	"	108	47	11	33.0	2.20	77.8	83.2
Abundance	"	109	48	11	34.8	2.42	66.2	83.0
Rennie's White Irish	"	109	47	12	35.1	2.41	67 7	82.9
Joanette	"	109	40	6	34.2	2.86	71.7	82.4
Bavarian	"	111	49	10	34.2	2.75	74.1	82.3
White Marvel	"	110	49	13	34.5	2.31	77.5	82.3
Golden Beauty	"	111	48	13	34.0	2.40	66.9	82.1
Improved Ligowa	"	108	47	12	35.4	2.34	66.4	82.0
Waverley	"	112	49	14	34.4	2.51	77.0	81.5
Probsteier	"	110	47	11	35.2	2.30	83.4	81.1
Swedish Wisconsin No. 4	"	108	48	13	34.1	2.20	64.8	80.8
Potato	"	109	46	13	35.5	2.32	71.3	80.0
New Sensation	"	109	45	11	35.2	2.33	65.1	79.9
Twentieth Century	"	108	46	14	34.3	2.17	57.7	79.8
Black Tartarian	Mane.	113	48	13	31.0	2.62	80.4	79.6
Scarboro	"	117	49	12	31.7	3.27	85.5	79.4
Black Anthony	"	111	48	13	31.0	2 96	80.6	79.2
Black Beauty	Spreading.	105	43	14	34.3	2.51	80.7	78.5
Canadian King	Mane.	109	48	14	33.5	2.56	63.2	78.0
Sheffield Standard	Spreading.	110	47	14	34.7	2.20	64.4	77.7
Early Champion	"	104	45	8	34.2	2.04	76.5	76.8
Storm King	Mane.	109	47	12	32.7	2.56	62.3	76.5
Early Ripe	Spreading.	98	41	6	28.0	2.07	70.3	76.5
Tobolsh	"	108	47	14	35.9	2.34	70.4	76.2
English Wonder	"	105	47	12	30.8	2.24	79.2	76.2
Early White Pearl	"	107	46	12	33.1	2.34	73.3	76.0
Egyptian	Mane.	110	48	12	36.8	2.80	61.8	75.7
Sunshine	"	116	47	14	29.2	2.76	77.9	75.5
Besler's Hafer	Spreading.	113	54	15	34.0	2.91	74.9	75.2
Prosperity	"	100	42	7	34.2	2.25	78.9	75.1
Goldfinder	"	115	46	17	30.7	2.53	71.2	73.2
Black Diamond	"	107	44	10	29.5	2.50	60.5	72.2
Tartar King	Mane.	108	48	14	34.8	2.31	60.6	70.4
Black Mesdag	Spreading.	99	46	12	30.8	2.26	65.8	70.4
Pioneer	"	107	42	16	34.3	2.55	62.4	69.6
Zhelannie	"	104	49	14	36.5	2.65	62.3	66.0
Early Dawson	"	104	49	13	38.4	2.79	60.6	62.7
White Superior Scotch	"	104	49	13	37.9	2.49	58.0	60.0
Hulless Oats	"	107	50	9	......	2.95	42.1	47.9

A Comparison of the Strength of Straw of a Few Varieties of Oats.

During the past few years, farmers have had a great deal of trouble on account of their oat crop becoming badly lodged before it was harvested. We take careful notes of the percentage of each crop which lodges in each year of the general experiments with the oats. During the last two years, however, a special experiment has been conducted by growing eight varieties of oats in duplicate on low land, in order to study very carefully the strength of the straw under rather severe conditions. The following table gives the percentage of crop lodged three weeks before ripening, and also at the time of ripening of each variety of oats in 1908, and also in the average of two years' experiments.

Varieties.	Percentage lodged three weeks before ripening.	Average 2 years.	Percentage lodged when ripe.	Average 2 years.
	1908.		1908.	
Siberian	15	10	77	49
Golden Beauty	12	9	73	67
Liberty	1	1	25	16
Sheffield Standard	15	10	90	75
Banner	2	2	53	31
Tartar King	1	1	89	77
Daubeney	55	28	94	51
Early Champion	23	13	92	56

These results present some interesting data. It will be seen that the Liberty variety of oats possessed the stiffest straw of all the varieties included in this special test. The American Banner also made a very good showing in this respect. One of the peculiar facts in reference to this experiment is that shown in the results of the Tartar King. This variety usually stands up splendidly during the earlier part of the season. On low land, however, the straw seems to become very brittle and lodges badly. Not only does this variety show the largest average amount of lodged grain, but owing to the peculiar character of the straw, it frequently bends at right angles or nearly so, and thus tends to check the flow of sap and makes the harvesting a very difficult matter. The Sheffield Standard, we find, lodges very badly both in our special and in our general experiments.

The average yields per acre of these eight varieties of oats on the low land were as follows: Liberty, 77.6 bushels; Banner, 73.4 bushels; Daubeney, 73.1 bushels; Golden Beauty, 64.1 bushels; Tartar King, 63.4 bushels; Sheffield Standard, 61.9 bushels; Early Champion, 60.3 bushels; and Siberian, 59.9 bushels.

Classification of Wheat.

There are a number of distinct types or species of wheat grown in Ontario. A study of the different classes of wheat is very interesting and instructive, as the different classes possess different characteristics. As several authorities divide cultivated wheat into seven distinct species, we here place the classification, and would suggest that if the reader would follow up the study of this classification he would undoubtedly be well repaid for his trouble. The species may be enumerated as follows:

(1) Common, fine, or soft wheat (*Triticum vulgare*).
(2) Turgid, or toulard wheat (*T. turgidum*).
(3) Hard, or flinty wheat (*T. durum*).
(4) Polish wheat (*T. polonicum*).
(5) Spelt (*T. spelta*).
(6) Emmer, or starch wheat (*T. dicoccum*).
(7) One-grained wheat (*T. monococcum*).

The greater number of the wheats of both the winter and the spring varieties which we grow in Ontario belong to the first class, and are used very largely for the production of flour.

Varieties of Winter Wheat for Flour Production.

About two hundred and sixty varieties of Winter Wheat have been grown at the Agricultural College within the past nineteen years. All varieties are carefully tested for a period of five years, after which the inferior kinds are dropped and the most promising sorts are continued in future tests. In 1908, sixty-five varieties were under experiment. Of this number, ten varieties have been grown for less than five years and fifty-five varieties for five years or over. As each of fifteen of the varieties has been grown for at least thirteen years, the average results of these are particularly interesting and valuable. The following table gives, for each of these fifteen varieties, the average weight per measured bushel for twelve years, the yield of grain per acre for 1908, and the average yield of both straw and grain per acre for the thirteen-year period:—

Variety.	Color of Grain.	Pounds per measured bushel 12 years.	Yield per acre.		
			Bushels grain 1908	Average 13 years.	
				Tons straw.	Bushels grain.
Dawson's Golden Chaff	White	60.0	43.9	3.3	55.4
Imperial Amber	Red	60.9	32.1	3.6	51.2
Early Genesee Giant	White	60.1	31.1	3.3	50.4
Russian Amber	Red	61.2	30.6	3.5	49.8
Egyptian Amber	Red	61.5	30.9	3.5	49.4
Early Red Clawson	Red	59.2	29.8	3.1	49.3
Rudy	Red	61.1	37.6	2.9	47.1
Tasmania Red	Red	61.8	28.5	3.2	46.3
Geneva	Red	62.5	35.4	3.2	46.0
Tuscan Island	Red	61.0	32.1	3.1	45.7
Turkey Red	Red	61.5	35.4	2.9	45.5
Kentucky Giant	Red	61.4	35.3	3.0	45.1
Bulgarian	White	60.8	24.3	3.0	45.0
Treadwell	White	60.7	26.9	3.0	44.8
McPherson	Red	62.0	24.9	2.9	43.8

The average results of the fifteen varieties are as follows: Weight per measured bushel, 62.8 lbs. for 1908, and 61 lbs. for the thirteen-year period; and yield of grain per acre, 31.9 bus. for 1908, and 47.7 bus. for the thirteen-year period. It will therefore be seen that in the experiments at the College in 1908, the winter wheat gave a comparatively light yield of grain, but that the grain was of superior quality.

The Dawson's Golden Chaff stands the highest in average yield of grain per acre of the fifteen varieties tested in each of thirteen years. It produces a very stiff straw of medium length, beardless heads with red chaff, and white grain somewhat soft but about the standard in weight per measured bushel. The Imperial Amber produces a large amount of straw which is rather weak, a bearded head with red chaff, and a red grain of average quality. The Early Genesee Giant furnishes a straw of medium length and of fair strength, a short, compact, bearded head, and a grain which is sometimes classed as white and sometimes as amber. The straw of the Tasmania Red, Geneva, Tuscan Island, Turkey Red, and Kentucky Giant is comparatively weak, but the grain is hard and weighs well per measured bushel.

Fifty-five varieties of winter wheat, grown in 1908, have been under experiment for at least five years. In the five years' test, the highest average yields of grain per acre have been produced by the Dawson's Golden Chaff (48.5 bus.), and seven other varieties which resemble it very closely and which yielded as follows: American Wonder, 51 bus.; New American Banner, 50.9 bus.; Abundance, 50.6 bus.; Beardless Rural New Yorker No. 6, 50.4 bus.; Prize Taker, 47.4 bus.; Superlative, 47.1 bus.; and Forty-fold, 46.6 bus. The highest average yields, produced by varieties of other types in the five years' experiment, are as follows: Genesee Reliable, 45.7 bus.; Paramount, 44.7 bus.; Egyptian Amber, 44.5 bus.; and Imperial Amber, 44.3 bus.

The heaviest weights of grain per measured bushel in the five years' test have been produced by the Northwester, 62.3 lbs.; Geneva, 62.1 lbs.; Kentucky Giant, 62 lbs.; Auburn, 61.9 lbs., and Genesee Reliable, 61.9 lbs.

Of the sixty-five varieties of winter wheat, grown in 1908, the greatest yields of grain per acre were produced by the American Banner, 47.5 bus; Beardless Rural New Yorker No. 6, 45.5 bus.; Dawson's Golden Chaff, 43.9 bus.; American Wonder, 42.8 bus.; Prize Taker, 39.5 bus.; and Genesee Reliable, 37.9 bus., and the heaviest weights per measured bushel by the Geneva, 64.4 lbs.; Egyptian Amber, 64 lbs.; Russian Amber, 64 lbs.; Genesee Reliable, 63.9 lbs.; Turkey Red, 63.9 lbs.; and Banatka, 63.9 lbs.

In 1906 and in 1907, fifty-seven varieties of winter wheat grown in the Experimental department were tested for bread production in the bakery branch of the Chemical department of the College. Those varieties of wheat which produced the largest loaves of bread from equal quantities of flour in the average of two years' experiments are as follows: Crimean, Red, Yaroslaf, Winter Red Fife, Banatka, Northwester, Turkey Red, McGarvin, Geneva, Rudy, and Tasmania Red. These varieties all possess red grain, and with two exceptions, bearded heads.

From the various varieties of wheats tested at the College, it seems to be generally true that white wheats yield more grain per acre, possess stronger straw, weigh a little less per measured bushel, are slightly softer in the grain, produce a more popular pastry flour, and furnish a somewhat weaker flour for bread production than the red varieties.

Varieties of Spring Wheat for Flour Production.

Although there is not nearly as much interest taken in the cultivation of spring wheat in Ontario as there was several years ago, still we find that in 1908, 142,124 acres were devoted to this crop. Not only have we had under experiment the different varieties obtainable in Ontario, but we have imported other kinds from various countries of the world and have tested them under similar conditions with those which we have grown in this Pro-

vince. As the tabulated results in a summary form for the spring wheats have not been placed in our report for some time, we are here presenting in a concise form the summary of our work with the different varieties of this class of spring wheat for the past five years.

Varieties.	Bearded or Beardless.	Color of Grain.	Average Height (ins.)	Per cent. of Rust.	Days to reach maturity.	Weight per measured bus. (lbs.)	Yield per acre. Straw (tons).	Yield per acre. Grain. ((bus.)
Minnesota No. 163	Ba.	Red.	46	6	121	58.9	2.15	34.1
Hungarian	Be.	Red.	41	5	116	62.1	2.05	33.5
Climax	Be.	Red.	47	6	119	59.1	2.14	31.9
Carleton	Be.	Red.	47	9	120	59.3	2.16	31.4
Red Fife	Ba.	Red.	45	8	120	58.2	2.05	31.3
Saxonka	Be.	Red.	46	6	119	59.8	1.96	31.2
White Russian	Ba.	Red.	43	9	121	58.0	1.91	31.0
Blue Democrat	Be.	Red.	46	9	119	58.9	2.07	30.8
Preston	Be.	Red.	43	10	115	59.1	1.82	30.8
Wellman Fife	Ba.	Red.	45	11	120	57.5	2.06	30.5
Kolben	Ba.	Red.	44	7	121	59.2	1.97	30.1
Herison Bearded	Be.	Red.	43	7	118	61.8	1.94	30.1
Pringle's Champion	Be.	Red.	46	8	119	58.1	2.10	29.7
Red Fern	Be.	Red.	46	8	119	29.3	1.93	29.6
Early Wonder	Ba.	Red.	46	5	123	57.8	2.11	29.5
Perron Red	Ba.	Red.	45	8	120	57.8	2.02	28.7
Minnesota No. 169	Ba.	Red.	45	6	123	58.4	1.88	28.6
Chubut	Ba.	Red.	41	19	115	60.5	1.91	27.1
Colorado	Be.	Red.	45	9	115	59.0	1.92	27.1
French	Be & Ba.	Red.	45	16	118	59.4	2.14	26.9
Perron White	Ba.	White	45	11	117	56.0	1.82	26.3

The Minnesota No. 163, which occupied the highest place in yield of grain per acre, is a special selection made at the Minnesota Experiment Station a few years ago under the guidance of Prof. W. M. Hays, who is now Assistant Secretary of Agriculture for the United States. Unfortunately, however, this variety has given a rather light weight per measured bushel, the average for five years being only 58.9 pounds, while that of the next following variety in the list is 62.1 pounds. I wish to draw particular attention to the wheat under the name of Hungarian, which now stands second in the list in yield of grain per acre. Not only does it give a very large yield, but the grain weighs on an average of 62.1 pounds per measured bushel, which is exceptionally high for spring wheat in Ontario. Although no baking tests have yet been made with this variety, the grain appears to be of good quality. The variety was imported from the Argentine Republic a few years ago through the kindness of one of our students who arranged to have this variety sent to us in order that we might test it in Canada, as it had been giving such good results in the Argentine Republic. We distributed this variety of wheat throughout Ontario in 1908 for the first time, and the average results of experiments conducted on fifteen different farms show that it gave a little larger yield of both straw and grain per acre, and was somewhat more popular with the experimenters than the Red Fife variety, which is well known throughout the Province, and is considered one of the very best varieties of spring wheats in Canada. It will be seen that the Hungarian variety has given a yield of about 2¼ bushels per acre more than the Red Fife in the average of five years' experiments at the College.

Varieties of Spring Wheat for the Production of Macaroni.

The varieties of wheat used for the manufacture of macaroni belong principally to the third species mentioned in the foregoing classification. Of this class of wheats, six varieties have been grown for sixteen years in succession. The following table gives the average results of seven varieties which we have had under careful test in each of the past five years:—

Varieties.	Bearded or beardl's	Average height (ins.)	Percent. of rust.	Days to reach maturity.	Weight per measured bushel (lbs.)	Yield per acre.	
						Straw (tons).	Grain (bus.)
Wild Goose	Be	45	3	121	63.0	1.89	36.7
Kubanka	"	45	4	120	62.2	2.11	36.3
Medeah	"	44	5	116	61.3	1.76	32.9
Sorentina	"	45	6	118	60.2	1.92	32.1
Bart Tremenia	"	41	4	119	61.4	1.78	32.1
Algiers	"	42	6	118	57.5	1.74	31.4
Ontario	"	51	9	130	56.4	2.26	25.3

The Wild Goose variety, which stands at the head of the list in yield per acre, is now grown over Ontario quite extensively, there probably being more acres devoted to this variety than to all other varieties of spring wheat combined. The Wild Goose wheat has been distributed throughout Ontario for a considerable number of years through the medium of the Experimental Union, and it has given large yields of grain throughout the Province. The Kubanka wheat is a variety belonging to the same class, and is giving excellent results in some of the semi-arid regions in the central western part of the United States. It has also made a very good record indeed in our own experiments at the College. The Roumania variety of wheat, which was furnished to us through the kindness of Dr. C. E. Saunders, of the Central Experimental Farm, at Ottawa, in the spring of 1907, has given us very good results in each of the past two years, producing a yield of 36.9 bushels per acre in 1907, and of 36.0 bushels per acre in 1908. A variety, known as the Iumillo, has become quite noted in certain parts of the United States for its great resistance to disease, surviving while practically all the others have succumbed to rust, etc., under severe climatic conditions. This variety gave a yield per acre of 29 bushels in 1906, 33 bushels in 1907, and 27 bushels in 1908. It has, therefore, given somewhat lower results than the Wild Goose variety in the yields of the past three years.

Varieties of Spring Wheat for Feeding Purposes.

When emmer was introduced in Ontario a few years ago under the name of spelt, we heard all sorts of comments regarding this grain. From the classification of wheat previously referred to, it will be seen that emmer and spelt are two distinct types. Each of these types or species of grain contains a number of varieties. They are used for grinding into meal for feeding to farm stock, owing to the fact that the chaff adheres to the grain

and is not removed in the process of threshing. The following table gives the average results of three varieties of emmer and of four varieties of spelt for a period of seven years:—

Classes of crop.	Varieties.	Average result for 7 years.			Pounds per measured bushel average of 6 years.	Aver. result for 7 yrs.	
		Per cent of rust.	Per cent of crop lodged.	Per cent of hull.		Tons of straw per acre.	Pounds of grain per acre.
Emmer	Common	3	29	22	39.2	2.2	3,145
	Iowa	2	22	21	40.0	2.0	2,910
	Russian	2	25	21	40.1	2.0	2,884
Spelt	Red	13	3	30	28.0	1 8	2,271
	Alstroum	18	4	30	28.2	1.8	2,282
	White	14	3	32	28.1	1.7	2,003
	Dasyanthum	15	11	29	28 3	1.7	1,869

The great superiority of the emmer over the spelt as a grain producer in Ontario is very clearly seen by the accompanying results. Not only does this prove true in our own experiments at the College, but it has also been quite manifest in the co-operative experiments throughout Ontario during the past few years. In practically all tests which have been made, the emmer yields decidedly heavier than the spelt. It will also be noticed that the emmer is much thinner in the hull than the spelt. There is a marked difference in the character of the straw of the two classes of grain, the straw of the emmer being very free from rust but somewhat inclined to lodge, while that of the spelt is comparatively stiff in character but is very subject to the attacks of the rust. The three varieties of emmer show an average variation of 261 pounds of grain per acre, and the four varieties of spelt a variation of 402 pounds of grain per acre. From feeding experiments conducted in some of the experiment stations in the United States, emmer has produced results not very much different from those obtained from barley.

Polish Wheat, Corn Wheat, or Colorado Giant Rye.

This grain has been sold under various names during recent years and received a good deal of sensational advertising in the newspapers, under the name of Corn Wheat, about five years ago. It is an old wheat and has been grown to a limited extent in many countries, under the name of Polish Wheat (Triticum polonicum). We have now grown the Polish Wheat for fifteen years in our experimental grounds, and the results have been comparatively low. In no one year has the yield per acre of the Polish Wheat surpassed that of the Wild Goose variety. In 1908, the Polish variety gave a yield of 23.8 bushels per acre, and a weight per measured bushel of 56.3 pounds. Although this wheat has been advertised for sale in Ontario at the rate of $7.00 per bushel, it will not likely be grown in this Province except as a sort of curiosity. As the heads are very large, the chaff prominent, and the grain very long, it is an interesting variety to have in a collection.

Turgid or Toulard Wheat (Alaska).

The Turgid wheat is mostly grown in central Europe, although this class of wheat has been grown in England under various names; such as, Rivets, Duckbill, Grey Pollard, etc. The grain is large and plump and

possesses a peculiar hunch on the back of each kernel. The varieties of this class which we have grown the most extensively at the Agricultural College are the Miracle winter wheat and the Seven Headed spring wheat.

The Miracle has a peculiar branching head of good size. This variety was grown at the Ontario Agricultural College previous to 1893. As it gave comparatively poor results, however, it was dropped at that time. It produced 20.6 bushels of grain per acre in 1891, and 27.7 bushels per acre in 1892.

The Seven Headed variety of wheat also possesses a branching head. It has been grown as a spring wheat at the Ontario Agricultural College each year since 1896. The following table gives the yield per acre of the Seven Headed wheat in comparison with the Wild Goose and the Red Fife varieties of spring wheat, in each of the years, from 1896 to 1908, inclusive:—

Year.	Red Fife.	Wild Goose.	Seven Headed.
1896	15.7.	20.4	2.5
1897	20.7	23.1	6.5
1898	34.2	48.3	24.7
1899	39.2	44.5	26.4
1900	46.3	48.4	39.4
1901	24.1	32.1	22.2
1902	31.9	33.5	25.0
1903	43.5	47.1	34.3
1904	22.2	47.1	33.2
1905	35.9	41.5	30.8
1906	33.9	36.0	28 2
1907	28.0	33.2	19.1
1908	36.3	25.6	24.5

The average yield per acre for each variety for the thirteen years was as follows: Red Fife, 31.7 bushels; Wild Goose, 37 bushels; and Seven Headed, 24.4 bushels.

The Alaska wheat, regarding which such extravagant claims have been made by means of private advertising and through the public press of the United States and of Canada during the past few months, evidently belongs to this class of wheat, and is very similar indeed to the Seven Headed variety. In order to obtain as full information as possible regarding the Alaska wheat, the writer communicated with the agricultural colleges in the States of Idaho and Washington and also with the originators and producers of the Alaska wheat. The Professor of Agronomy at the Idaho Agricultural College wrote, under date of August 27th, 1908, that he saw no reason for doubting that the Alaska is the ordinary Miracle or Egyptian wheat (*Triticum turgidum*), of which Eldorado and Seven Headed are two of the varieties. He also stated that the very best fields of Alaska wheat in Idaho in 1908, did not exceed 35 bushels to the acre, and that others gave considerably less than this amount. The Director of the Agricultural Experiment Station of the State of Washington wrote on August 26th, 1908 as follows:

"I will say that the wheat in question is undoubtedly the same thing as the old Miracle or Seven Headed wheat."

The writer wrote to the promoters of the Alaska wheat with the hope of securing some of the seed for sowing in the experimental grounds at the College, but was unable to purchase a small quantity for experimental purposes. The crop of 1908 was advertised at $20.00 per bushel. The wheat

certainly resembles very closely indeed the Seven Headed variety, which we have grown at the College for many years with comparativley poor results.

*Farmers who pay **high** prices for the so-called **new** varieties of farm* crops before the experimental stations thoroughly investigate the matter have themselves to blame. The writer believes that there are not many farmers in Ontario who are led astray by the sensational advertising of farm crops with the object of enriching the promoters of these new and wonderful varieties. The Government of Ontario is doing much to protect the farmers by its extensive system of experimental work conducted at the Ontario Agricultural College and through the medium of the Experimental Union.

Varieties of Winter Rye.

Four varieties of winter rye have been grown in the Experimental department in each of the past five years, and the following are the average results in yield of grain per acre and in weight of grain per measured bushel: Mammoth White, 63.3 bus.; 57.8 lbs.: Washington, 59.5 bus.; 58.1 lbs.: Common, 55.2 bus.; 57.0 lbs.: and Thousand Fold, 54.3 bus.; 57.5 lbs.

Varieties of Spring Rye.

Four varieties of spring rye were under test in 1908, giving yields per acre as follows: Saatroggen, 23.8 bushels; Prolific Spring, 19.2 bushels; Dakota Mammoth, 18.1 bushels; and Common, 18 bushels per acre. Each of these varieties has been grown for five years in succession, the greatest yield being produced by the Saatroggen with 30 bushels, and the second greatest yield by the Dakota Mammoth with 28.7 bushels per acre. The Saatroggen gave a yield of 36.5 bushels per acre in 1907, which is the highest yield obtained from any of the varieties during the past five years. From one selected strain of the Saatroggen variety, however, which we have had under experiment for the last three years, we have obtained very excellent results, the yields being as follows: 1906, 35.6 bus.; 1907, 37.8 bus.; and 1908, 27.4 bus. per acre. These yields surpassed all the others in each of these years. This selected strain of the Saatroggen variety of spring rye is certainly very promising.

Varieties of Buckwheat.

We here present the average of four years' results in growing each of five varieties of buckwheat in the Experimental department, which are as follows:

Varieties.	Lbs. per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
Rye Buckwheat	53.0	2.3	32.7
Silver Hull	51.7	2.5	23.5
Common Grey	46.5	2.8	21.5
New Calcutta	50.9	2.4	20.7
Japanese	45.2	2.3	17.5

The Rye buckwheat, which stands the highest in yield of grain per acre, has been grown for only a few years at the College, but it is by no means a new variety. It is the Rye buckwheat which is grown extensively

in Nova Scotia. It is sometimes called Sand, Notched, or Rough buckwheat. One of the difficulties which we have observed in growing this buckwheat in Ontario is the fact that the crop seems to ripen more unevenly than that of the other varieties. At the same time that some of the seed is ripened other seed is still quite green, and in fact blossoms can be found on the outer end of the branches. The Japanese buckwheat has given comparatively poor results during the past few years. It seems to thrive best when the season is comparatively warm and dry.

Three varieties of buckwheat have now been grown in the Experimental department in each of eleven years, the following being the average yield of grain per acre per annum: Silver Hull, 19.8 bus.; Japanese, 19.6 bus.; and Common Grey, 18 bus. In 1908, the Rye buckwheat produced decidedly *the largest results of grain per acre in the comparative tests.*

Varieties of Field Peas.

Twenty-seven varieties of field peas were grown at the College in 1908. Owing to the ravages of the pea weevil in South Western Ontario for a period of several years, no experimental work was conducted with this crop in our experimental grounds. This was due largely to the fact that many farmers had stopped growing peas entirely, and it was thought that with a united effort the pea weevil might be exterminated to a considerable extent. As the weevil has largely disappeared, the cultivation of the crop is again *increasing throughout the Province.* In the results of the experiments with the twenty-seven varieties of peas grown at the College in 1908, we find that the greatest yields were produced by the Early Britain, 39.1 bus.; Potter, 34.1 bus.; New Canadian Beauty, 33.6 bus.; and Black Eyed Marrowfat, 33.5 bus. These were the only varieties which gave a yield of more than thirty bushels per acre.

Eight varieties of peas have been grown at the College in each of nine years. As these varieties include some of the common kinds, such as, the Golden Vine and the Multipliers, and some of the newer introductions, such as, the Early Britain and the New Canadian Beauty, we present the average results of the experiment which was conducted in each of nine years.

Varieties.	Days to mature. Average of 12 years.	Length of vines. Average of 7 years.	Average results for 9 years.		
			Weight per measured bushel.	Tons of straw per acre.	Bushels of grain per acre.
		ins.	lbs.		
Early Britain	102	40	57.3	1.37	38.3
Potter	103	46	59.6	1.44	35.1
New Canadian Beauty	105	49	60.5	1.42	32.5
White Eyed Marrowfat	105	44	60.6	1.53	31.8
Black Eyed Marrowfat	106	44	59.7	1.37	30.1
Prussian Blue	107	49	60.0	1.60	29.7
Multipliers	109	51	60.5	1.75	28.5
Golden Vine	105	43	60.1	1.41	28.3

It will be seen that the Early Britain, which gave the highest yield of twenty-seven varieties of field peas grown at the College in 1908, has also given the highest yield per acre in the average of nine years' experiments with each of eight varieties. It will also be observed that the Potter variety

stands second both for 1908 and for the average of nine years. The Golden Vine, which is a small white pea, has been grown throughout Ontario extensively and is possibly the best known of all the varieties on the list. It is the common small white pea of Ontario. In the average results for the nine years, however, it occupies the lowest place in yield of grain per acre.

Varieties of Field Beans.

Fourteen varieties of field beans were under experiment at the College in 1908, and the results show that the greatest yields per acre were produced from the Burlingame Medium, New Prize Winner, Pearce's Improved Tree, Small White Field, Red Kidney, and Yellow Eyed Marrowfat varieties. *Besides the fourteen varieties, five selected strains of four of the* varieties were grown under similar conditions to those used for the variety test. It was found that a selection of the New Prize Winner gave a greater yield per acre than any of the varieties referred to.

As eleven of these varieties have been grown in each of ten years, the average results are very valuable and are presented as follows:

Varieties.	Average results for 10 years. Weight per measured bushels. (lbs.)	Grain per acre. (bushels.)
Pearce's Improved Tree	64.9	24.0
Burlingame Medium	64.6	22.5
White Wonder	64.7	22.1
Medium or Navy	64.8	21.5
Schofield Pea	65.1	21.4
Day's Improved Leafless	65.0	21.0
Buckbee's Electric Tree	65 0	20.0
Marrowfat	64.4	19.7
Boston Pea	65.0	19.0
Small White Field	64 1	18.2
Large White Haricots	58.0	15.9

In the average of ten years' results of each of eleven varieties of field beans, it will be seen that the Pearce's Improved Tree gave the greatest yield with 24 bushels per acre, which was followed by the Burlingame Medium with 22.5 bushels and the White Wonder with 22.1 bushels per acre. In weight per measured bushel, all varieties with the exception of the Large White Marrowfat, gave considerably more than 60 pounds per measured bushel, which is the standard weight for beans in Ontario. Four of the varieties gave an average of 65 or more pounds per measured bushel, the highest being produced by the Schofield Pea variety of beans.

Hairy Vetches for Seed Production.

During recent years, the Hairy Vetches have been considerably advertised for use as a farm crop. They have yielded well as a fodder crop, have furnished a considerable amount of pasture, and have been very highly spoken of as a cover crop for fruit orchards. The seed, however, is nearly all imported from across the Atlantic and is very expensive, usually costing fully $5.00 per bushel, and for general purposes from sixty to ninety pounds of seed are sown per acre. In each of the past seven years, the

airy Vetches have been sown in the autumn and allowed to ripen in the ollowing year in connection with our experimental work at the College. n the average results for seven years, we obtained 5 bushels of the seed er acre per annum. It is, however, a very uncertain crop, as over 18 ushels per acre were obtained in one year and less than one bushel per :re was all that was realized in another year of this experiment. We find, owever, by continuous growing of the Hairy Vetches and by thus using anadian grown seed, we get decidedly better results than we do from seed hich we have imported.

Grass Peas and Soy Beans.

Although Grass peas were grown quite extensively in the vicinity of :amilton and in some other portions of the Province previously, the results om this crop have not been very satisfactory during the past few years, ving possibly to the seasons being somewhat colder and the rainfall a ttle heavier than the average. The Grass peas are used for green fodder, r cured hay, or for the production of grain.

The Soy beans are grown extensively in Japan, and their cultivation i the United States and in Canada, although yet very limited, has prob- bly been increasing slightly. The crop furnishes exceedingly rich feed r farm stock. They can be fed in the green condition or placed in the lo with corn, or the crop can be threshed and the grain ground into meal. he meal is richer than that made from any of our ordinary farm crops, en including peas. There are a number of varieties of soy beans, but ost of them are entirely unsuited for growth in Ontario, owing to the ngth of season which they require for their development and maturity. he Early Yellow variety, however, has proven to be one of the best for ost parts of the Province, as it yields very well and matures early. In e average results of growing the Early Yellow soy beans at the College for irteen years, we find the production to be 15 bushels of the threshed seed r acre. As the Grass peas and each of three varieties of soy beans have en grown under similar conditions in each of the past four years, we esent the average results of these four different varieties of leguminous ops. The results were much lower in 1908, than usual.

Varieties.	Yield of Grain per acre. (lbs.)	
	1908.	Average 4 years.
ass Peas	472	634
edium Green Soy Beans	474	1,031
San Soy Beans	430	932
rly Yellow Soy Beans	635	915

From these results it will be seen that the Medium Green surpassed e Early Yellow variety. It is, however, more difficult to cure the grain the Medium Green soy beans as compared with that of the Early Yellow iriety, owing to the fact that the former is later in reaching maturity.

Varieties of Flax.

Varieties of flax were obtained from Ontario, Manitoba, Holland, Russia, and from the Argentine Republic in the spring of 1905, and the varieties have been placed in comparative tests in our experimental grounds since that date. Six different quantities of seed per acre were used with each of the four first mentioned lots of flax, and this experiment was repeated in each of the past three years. In averaging the results of the six plots of each lot of flax for the four years, we obtained the following comparative yields of seed per acre: Manitoba flax, 18.9 bus.; Common flax, 17.9 bus.; Russian flax, 16.1 bus.; and Holland flax, 13.9 bus.

In another experiment we have made a comparison of seven different varieties of flax obtained from various sources. In the experiment for 1908, as well as that in 1907, the greatest yield of seed per acre was produced from the flax obtained from the central province in the Argentine Republic. Further experiments will be conducted with this variety of flax.

Varieties of Millet Grown for Seed.

Twenty-two varieties of millet were grown in our experimental grounds in a comparative test for seed production in 1908. Of this number, thirteen varieties have been grown for the last five years in succession. Those varieties producing the greatest average yield of seed per acre per annum were as follows: Siberian, 55.2 bushels and Steele Trust, 52.5 bushels. The Siberian variety has produced a very high yield of seed per acre in each of the years, the lowest being 39.5 bushels in 1908, and the highest 87.3 bushels in 1905.

Varieties of Corn for Husking.

Although 233,753 acres of corn were grown for the silo in Ontario in 1908, we find that no less than 299,690 acres were used for the production of corn for husking. Of this area, 77,449 acres were in Essex, 65,965 acres in Kent, 22,602 acres in Elgin, 20,069 acres in Lambton, and 16,974 acres in Middlesex counties. It will, therefore, be seen that the extreme south western portion of Ontario is the great centre for the growing of corn for grain production.

In 1908, eighty-eight varieties of corn were grown and the husked ears of each variety were carefully stored in racks and placed in the experimental barn. After the grain had become sufficiently dry, it was shelled and the yield of the shelled grain was determined for each variety. We find that the greatest yields in bushels per acre for the past year were produced by the following varieties: Farmers' Surprise, 70.1; Burlington Hybrid, 67.4; Early California Flint, 66.1; Wisconsin Little Dent, 65.6; White Cap Yellow Dent, 64.3; and Little Dent, 64.3.

Each of nine varieties of flint corn have been tested at the College for grain production in each of eight years. The following table presents the average of the eight years' results of these varieties of corn.

It will be seen that six of the varieties of corn here reported on have given an average of over 50 bushels per acre, one of the kinds; viz., the King Phillip, producing as high as 61.3 bushels of shelled grain per acre. Both the King Phillip and the Genesee Valley, which have given the highest results in the experiments at the College, have also given excellent

ults in the co-operative work throughout Ontario. The Compton's Early, ich is well known over Ontario as being an early twelve-rowed variety

Varieties.	Color of grain.	Average number of rows per ear.	Number of days until in full tassel. Average of 5 years.	Height of plants. Average of 5 years. (ins.)	Average of 8 years results.	
					Percentage of cob.	Grain per acre. (bushels.)
g Phillip	Red	8	83	98	25	61.3
iesee Valley	Yellow	8	81	96	25	58.1
;fellow	"	8	85	96	24	54.4
mers' Friend	"	8	78	74	21	53.1
Blazed	Red and yellow	8	81	96	25	52.6
ada Yellow	Yellow	8	86	99	26	51.5
ipton's Early	"	12	85	100	30	49.8
lington Hybrid	White	8	87	93	29	49.5
er's North Dakota	"	8	88	100	32	45.9

yellow flint corn, has produced an average in yield of grain per acre siderably lower than a number of the other varieties.

WHITE CAP YELLOW DENT CORN FOR GRAIN PRODUCTION.

As the White Cap Yellow Dent corn is grown extensively by a large nber of farmers in the south western part of Ontario, it was considered e to test this corn more carefully in the Experimental department. A nber of painstaking farmers have been growing this variety for a conerable number of years and have carefully selected the best ears from r to year, and as the corn has become somewhat changed in its growth ough its continuous selection and through its different environment, experiment has been conducted with seed obtained from the different wers. The following table gives the average results of two tests conted in each of the past two years in average height and total yield per e, and also of the duplicate tests conducted in 1907 and in 1908 for grain duction.

County.	Grower.	Average results for 2 years.				
		Number of days until in full tassel.	Height. (ins.)	Percentage of cob.	Tons of total crop per acre.	Bushels of grain per acre.
ex	J. Hammond	77	111	21	13.70	52.7
dlesex	E. M. Zavitz	76	116	24	14.78	51.8
ex	W. Bryham	79	111	20	13.85	47.3
ex	J. Thomas	80	116	22	13.63	44.0
ex	C. Wigle	81	119	27	16.48	36.6

It will be seen that there is quite a variation in the results obtained m the White Cap Yellow Dent corn, the seed of which was obtained m different sources. These differences are, in all probability, due to the

various selections made by the different individuals for a considerable length of time under different conditions of environment. The greatest yield of shelled grain per acre was produced from the seed obtained from Hammond, and the lowest yield was produced from the seed obtained from Wigle. In view of total crop per acre, however, the seed obtained from Wigle produced the largest yield in each of the past two years.

Sunflowers for Seed.

It is quite true that sunflowers are not grown to any great extent as an economic crop in Ontario, and yet they are producers of large yields of seed. No less than seven varieties of sunflowers have been tested in the Experimental department, and of this number three have been grown for ten years in succession. Taking the standard weight for sunflower seed as being 20 pounds per measured bushel, we have obtained a yield in the average of ten years of 76.1 bushels from the Mammoth Russian, 75.9 bushels from the White Beauty, and 69.1 bushels from the Black Giant. These are certainly large yields per acre, but probably not much larger than might be expected from growing sunflowers under fairly good Ontario conditions. For this experiment, the seed is planted about the same as corn. Some farmers harvest the heads of the sunflowers and run them through the cutting box along with corn when filling the silo, considering that the silage is improved in quality thereby, owing to the fact that the sunflower heads contain a large amount of oil. The seed is quite frequently used as feed for poultry.

Varieties of Sorghum for Seed.

Thirteen varieties of sorghums were grown in 1908 for seed production. Of these, the greatest yields were obtained from the Australian Broom Corn, the Early Japanese Broom Corn, and the Chinese Cud Grass. In the average of six years' results we have obtained yields per acre as follows: Early Japanese, 29.1 bus.; California Golden, 28.7 bus.; and Improved Evergreen, 27.8 bus. In 1908, the yield of seed was comparatively light, being 20 bushels per acre for the Early Japanese, and slightly over 16 bushels per acre for each of the other two here mentioned.

Varieties of Potatoes.

The market value of the potatoes grown in Ontario in 1908, amounted to about twelve million dollars, but the acreage was slightly less than that of the previous year.

One hundred and eleven varieties of potatoes were grown in the Experimental Department in 1908. The crop was entirely free from rot, and the potatoes were of good quality. The highest yields per acre in 1908, were produced by the Holborn Abundance, 272.5 bushels, Early Michigan and Pearl of Savoy each 270 bushels, Montana Bluff 265 bushels, Rose's New Invincible 264.2 bushels, and Dempsey's Seedling 262.5 bushels. The Holborn Abundance also occupied the highest place in yield of potatoes in 1904, and also gave the sixth highest yield per acre in 1906. The Dempsey's Seedling which came sixth in the list in 1908, occupied third place in the yield of potatoes per acre in the year previous. Sixty-six varieties of potatoes have been grown in the Experimental Department in each of the five years. From a study of the experiments with different varieties of potatoes grown both at the College and throughout Ontario, we find the following to be amongst the best, when yield, size, freedom from rot, and

table quality are all taken into consideration: Late varieties; Empire State, Dempsey's Seedling, Rural New Yorker No. 2, and American Wonder: Medium varieties; Rose of the North and Burpee's Extra Early: Early varieties; Extra Early Eureka, Early Fortune, Early Puritan, and Early Harvest. The Holborn Abundance which is a late variety, has also made a high yield of potatoes per acre. From inquiries made throughout Ontario, from a large number of farmers, in both 1907 and in 1908, we learn that the varieties which are most extensively grown throughout Ontario are the Rural New Yorker No. 2, and the Empire State. Both these popular varieties of potatoes are white in color, good yielders, and generally of good quality. The Empire State has proven to be one of the very best in table quality, of some two hundred different varieties which we have tested at the College. The Rural New Yorker No. 2 is apt to grow rather coarse and produce hollow potatoes, on some of the rich soils in Ontario. On a sharp, warm, light soil however, the quality of the Rural New Yorker No. 2 variety is generally very good. It seems as though it would be wise for the farmers in the potato growing districts to confine their attention more particularly to the growing of one or two varieties of potatoes which yield well, are of good quality, and meet the requirements of the market, rather than divide their attention over so many different kinds. If large quantities of potatoes of the same variety, could be purchased, it would form great inducements for buyers to go into the localities and pay good prices.

Treatment for the Potato Beetle.

In the spring of 1908, we received a large can of Phenyle for the treatment of seed grain and potatoes, for the prevention of the ravages of insects. I take the following quotation from a letter received under date of March 18th.: "It will protect potatoes from potato bugs, if the seed is sprinkled with Phenyle." We conducted an experiment by sprinkling seed potatoes lightly and also quite heavily, and by planting the potatoes thus treated beside others which had not been treated. The experiment was conducted in duplicate, and careful observations were made. The results of the experiment show that the potato vines produced from the potatoes which had been treated with Phenyle were as badly attacked by the potato beetle as those which had not been treated in any form. In order to test the influence of different treatments for the Potato Beetle, six lots of each of two varieties of potatoes were carefully selected and planted on separate plots, in each of five years. After the potatoes had made sufficient growth and the Potato Beetles (Bugs) had made their appearance, five plots of each variety were treated in different ways, to destroy the beetle, and one plot of each variety was left untreated, as a basis of comparison. The five treatments made in each of the years were as follows: (1) Paris Green and water, by using one pound of Paris Green and 96 gallons of water per acre; (2) Paris Green and plaster, by using one pound of Paris Green and 38 pounds of plaster per acre and applying the mixture to the potatoes in the dry condition; (3) Potato Bug finish, which was applied dry at the rate of 20 pounds per acre; (4) Bug Death and water, by using on an average 32 pounds of Bug Death and 96 gallons of water per acre; and (5) Bug Death used in the same proportion as No. 4, but in the dry condition. Three applications of each of the five treatments were made with each of the two varieties of potatoes. In the autumn, the potatoes from each of the twelve plots were dug and weighed. The average results of the experiment conducted for five years in succession, showing the yields in bushels per

acre from each treatment, are as follows: Bug Death and water, 211.4; Bug Death dry, 203.5; Paris Green and water, 199.6; Paris Green and plaster, 183.3; Potato Bug Finish, 145.3; and untreated, 104.3.

In eight out of the ten tests made during the five years, those potatoes which were sprayed with Paris Green and water surpassed those which were dusted with Paris Green and plaster in yield of crop per acre. It will also be observed that the Bug Death and water gave better results than where the Bug Death was used in the dry condition. The Bug Death in solution gave considerably larger yields of potatoes per acre than the Paris green and water. From the potatoes which were left untreated and on which the potato beetles were allowed to work unmolested, there was less than half the yield of potatoes, as compared with the crop produced from the treatment with Bug Death and water. The usual prices of these insecticides when bought in quantity are about as follows: Paris green 20 cents; Bug Death, 7 cents; and Potato Bug Finish, 1 2-3 cents per pound. The cost therefore for the material used in the experiments conducted in the last five years was about as follows: Paris green and water, 60 cents; Paris green and plaster, 88½ cents; Bug Death, $6.72; and Potato Bug Finish, $1.00 per acre.

Other Experiments in Potato Growing.

A very large number of experiments with potatoes have been conducted in the Experimental department within the past twenty years. Many of the results of these experiments have been summarized in past reports of the College. Other tests with spraying mixtures, in the use of fertilizers and manures, in the selection of seed, etc., are now under way and we hope to obtain some valuable results when the experiments are conducted for a longer period of time.

Varieties of Mangels.

In 1908, 67,937 acres were devoted to the growing of Mangels in the Province of Ontario. When we realize the fact that the number of acres of Mangels in the Province, was 15,791 in 1882, 34,383 in 1895, and 67,937 in 1908, it shows the importance and the increase in the growth of the Mangel crop in connection with our agriculture. It seems quite safe to say that the Mangel crop is increasing in popularity from year to year. It is probably owing to the increase in the dairy industry and to the introduction of better varieties of Mangels, that the acreage devoted to this crop has been largely increased in late years. Mangels usually produce a large yield of roots which keep well and are relished by farm stock, and do not taint the milk when fed to milch cows. In 1908, twenty-seven varieties of Mangels were grown in the Experimental Department of the College. During the five years previous to 1908, the Yellow Leviathan variety of Mangel, produced the greatest average yield of roots per acre. There are three seedsmen in Ontario who advertise this variety in their catalogues, viz., Steele Briggs Seed Co., Toronto, D. M. Ferry, Windsor, and Jas. Hewer, Guelph. Therefore seed was obtained from each of these three sources and tested at the experimental grounds, with the result that each of these lots gave slightly over thirty tons of roots per acre, and yielded within one ton of each other. These were the only three lots that gave a yield of upwards of thirty tons of roots per acre. They were followed quite closely, however, by the Griewener Mangel, with 29.6 tons, Carter's Windsor Prize Taker Yellow Globe, 29.1 tons, and Sutton's Mammoth Long Red, 29 tons per acre.

In averaging results for the past five years, we find that the following varieties have produced the greatest average annual yields per acre.

Varieties.	Color of Roots.	Form of Roots.	Tons per acre.
Yellow Leviathan	Orange	Intermediate	32.6
Griewener	Yellow	Tankard	32.6
Ideal	Yellow	Tankard	32.0
Giant Eckendorf	Yellow	Tankard	32.0
Evans' Improved Mammoth Sawlog	Red	Long	32.0
Sutton's Mammoth Long Red	Red	Long	31.5
Long White	White	Long	31.4

It will be observed that the four highest yielding varieties of mangels in the average results for five years are either intermediate or tankard in form. The Evans' Improved Mammoth Sawlog and the Steele's Long Red Selected are very similar in form and in color, and the average results for fifteen years show a difference of less than one ton per acre. It is claimed that during the last three or four years, the seed of these two mangels has been obtained from the same source, and that the varieties are now identical. The Yellow Leviathan has been used in connection with the co-operative experiments throughout Ontario for five years, and has made a very high record indeed, being first in the list in four out of the five years in yield of roots per acre. Not only is it the highest yielder, but it also produced roots of a compact form, which are easily harvested, and are good in both keeping and feeding quality.

Canadian Grown Mangel Seed. But very little mangel seed is grown in Ontario, nearly all being imported from Europe. Owing to our severe winters and the cost of labour, it is difficult to produce root seed to compete with that imported from other countries where the climate is milder and the labour is much cheaper.

In the autumn of 1905, some very nice roots were selected from those grown in the experimental grounds and stored during the winter, and in the spring of 1906, were re-planted. From some of these, seed was obtained in the autumn, and was sown in the spring of the following year, in the experimental grounds. The yield obtained from the seed of the individual plants, varied considerably, but, on the whole, the results were very satisfactory. The seed from four of the plants gave higher yields than any of the twenty-six varieties of mangels grown in that year, from the seed which was imported. In the autumn of 1906 similar selections of mangels were made, and these were replanted in the spring of 1907. Owing, no doubt, to the peculiar weather conditions in the autumn of that year, the plants did not ripen their seed as satisfactorily as in the year previous. The results from our own seed in 1908, therefore, were not quite as satisfactory as those of the year previous. We were very successful, however, in producing excellent seed, during the past year, and have a larger quantity of this seed for experimental purposes in 1909 than on any previous occasion.

Varieties of Sugar Beets.

Two classes of sugar beets are grown in Ontario, one as feed for live stock and the other for sale for the production of sugar. With the first

object in view, the varieties mostly grown have roots of good size which grow considerably out of the ground and contain about 10 per cent. of sugar. When the object is sugar production, those varieties are grown whose roots grow almost entirely under the ground and which contain on an average, about 15 per cent of sugar. The roots of the varieties of sugar beets for sugar production, are also considerably smaller than those grown for feeding on the farm.

In 1908, twenty-one varieties of sugar beets were grown at the College, Of this number, the greatest yields were produced by the Giant White Feeding, Rennie's Jumbo, and Rennie's White Half Sugar. Of the twenty-one varieties referred to, fourteen of them have been grown for five years in succession. These include varieties which are usually grown for feeding to farm stock, as well as those which have been selected for many years, for the production of a high percentage of sugar. All varieties were grown in rows twenty-one inches apart, and the roots were thinned to a distance of seven inches apart in the rows. Those varieties which gave the highest average yield per acre for five years, are as follows:

Varieties.	Length in inches.		Percentage of Sugar.	Tons per acre.
	Above ground.	Under ground.		
Giant White Feeding	3.8	4.6	8.1	30.2
Tankard Cream	3.0	4.0	*8.6	25.5
Royal Giant	2.8	5.2	10.2	25.1
Giant Rose Feeding	3.2	5.2	13.0	24.1
Imperial Giant Half Sugar	2.9	4.9	†10.6	23.0
Rennie's Giant Sugar			†10.3	23.0
New Danish Improved	2.8	5.2	11.1	22.9
Hybrid Sugar Beet Mangel	2.4	5.6	†10.5	22.9
Red Top	1.9	5.9	11.2	22.1
White Silesian	1.0	6.1	13.7	20.9

* Average for four years. † Average for three years.

The Giant White Feeding variety of sugar beets is certainly a heavy yielder of roots per acre, the average being over four tons greater than that of the next highest yielding variety. It will be observed, however, that the sugar content of this variety is comparatively low. The Giant White Feeding not only gave a higher yield per acre than all the other varieties but one at the College in 1908, and stood at the top of the list in the average results for the past five years, but it has also given the highest average results in the co-operative experiments throughout Ontario, during the years which it has been distributed to various farmers for testing on their own farms.

Varieties of Swede Turnips and Fall Turnips.

Twenty-one varieties of Swede Turnips and four varieties of Fall Turnips were sown in the Experimental department in the summer of 1908. Owing to a lack of uniformity in the germination of the seed and the peculiar, warm, dry autumn weather which favored the development and the ravages of the plant lice, the results from both the Swede Turnips and the Fall Turnips, are unsatisfactory and unreliable, and are therefore not presented in this report.

VARIETIES OF FIELD CARROTS.

Acording to the latest report of the Bureau of Industries of Ontario, there were slightly more than four thousand acres devoted to the growing of Field Carrots in Ontario in 1908, and the average yield per acre for the Province, was 275 bushels. Nineteen varieties of field carrots were grown in the Experimental department in 1908. Of this number, fourteen varieties have been grown for five years in succession. Those varieties which have produced the highest average yield per acre for five years, are as follows:

Varieties.	Color.	Length of Roots in inches.	Tons per acre.
Steele's Improved Short White	White	8.6	30.5
Mastodon White Intermediate	White	8.9	29.2
Mammoth Intermediate Smooth White	White	8.5	29.1
Carter's Hundred Ton	White	8.2	28.1
Simmers' Improved Giant Short White	White	8.4	28.1
Sutton's Matchless White	White	8.5	27.1
Large White Vosges	White	6.6	24.7
Large White Belgian	White	11.1	24.6
Long Yellow Stump Rooted	Yellow	8.8	24.5

The intermediate White varieties of carrots are now taking the lead, not only in the yield at the College, but also in general cultivation throughout the Province. The Long White Belgian which used to be grown quite extensively, and which produced a comparatively light yield of roots, and was very difficult to harvest, has been dropped almost entirely out of the general cultivation.

As in the case of the mangels, the results from Canadian grown seed was not very satisfactory in 1908, which was probably owing to the fact of the unfavorable weather conditions when the carrot seed was maturing in the previous year.

VARIETIES OF KOHL RABI.

Kohl Rabi resembles cabbage in its root, and Swede Turnip in its leaf growth. The valuable part, however, grows about three inches above the ground, in the form of a bulb. It makes excellent food for domestic use, and is prepared for culinary purposes in much the same way as the Swede Turnip. Although grown to a certain extent in the Old Country as feed for sheep and other farm stock, it has not been grown to any great extent for farm purposes in Ontario. Four varieties were grown in the Experimental department in 1908, and three of these varieties have been under test in each of seven years. In 1908 the highest yield was produced from the Earliest Erfurt, and the second highest from the Early White Vienna. In the average results for the seven years, however, the Early White Vienna gave an average of 19.5 and the Early Erfurt, 19.5 tons per acre, while the Goliath Purple variety gave an average of only 16.2 tons per acre.

VARIETIES OF PARSNIPS.

In order to obtain some information on the growing of parsnips with the object of feeding the same to farm stock, an experiment has been conducted in each of the past five years, in comparing, two different varieties. The

average results for the whole period, show that the New Ideal Hollow Crown gave 10.6, and the Sutton's Cattle, 9.7 tons per acre per annum. The yields in 1908 were smaller than those for any of the four years previous, while those for 1907 were the largest of the five year period. It will be seen that the yields per acre given by the parsnips, are not nearly as large as those from the other principal classes of field roots. Although some inquiry has been raised regarding the value of parsnips as a crop for feeding farm stock in Ontario, our results so far have not justified the recommendation of the growing of this crop for that purpose, to any general extent.

Storage of Roots.

In each of the past five years, mangels, sugar beets, turnips and carrots have been pitted in the field, stored in the root cellar, and packed in boxes in sand, in order to get some information regarding the best methods of keeping roots, especially when the roots are for transplanting in the following spring for the production of seed. As it seems rather difficult to pit a small quantity of roots and have them under the usual conditions in which roots are pitted, this part of the experiment has not proven very satisfactory. In the other method of storing, however, we have found that the roots which were stored in piles in a cool root cellar, have come through the winter fully as well as those packed in sand, but in the latter case there was less sprout and mould, and rather more decayed roots.

Varieties of Corn for Green Fodder, Dry Fodder, and the Silo.

A somewhat smaller area is devoted to the fodder corns than to the husking corns in Ontario at the present time. The corn crop, where it can be grown successfully, furnishes a heavy yield per acre of both coarse fodder and of grain. The acreage devoted to this class of corn in Ontario increased from 200,354 acres in 1907 to 233,753 acres in 1908, according to the latest report of the Bureau of Industries for the Province of Ontario. There was also an increase in the yield per acre from 10.1 tons in the former to 11.7 tons in the latter. Those counties in Ontario which produced the largest quantities of these corns in 1908 are Oxford, 192,165 tons; Middlesex, 163,005 tons; Carleton, 143,949 tons; Dundas, 115,411 tons; Huron, 113,517 tons; Hastings, 105,901 tons; and Leeds, 105,456 tons. It will therefore be seen that the fodder corns are largely grown in those counties of Ontario in which dairying is developed to a large extent, although many of the other counties are now devoting a considerable amount of attention to the fodder corns. There are scarcely any parts of Ontario in which some one or other variety of corn will not thrive satisfactorily, unless it is in the Northern districts. Even beyond the limits where it was thought that corn could be grown, certain varieties have been cultivated and even ripened with a considerable amount of satisfaction. It is of the greatest importance, however, to grow those varieties which are particularly suited to the localities in which they are grown. It is important for each farmer to do a certain amount of experimental work for himself. Before doing so, however, he will find very great assistance from results of experiments which we have conducted at the College with a large number of varieties, where not only the total yield per acre, but also the yield of ears, stage of maturity, etc., are taken into consideration. The variety test conducted at this Station should serve as a general guide to the farmers in most parts of Ontario, indicating to them the kinds which are likely to be suitable for their respective localities. It is indeed impossible to mention any one variety of corn which is most suitable

for Ontario. The requirements of the various localities are so very different that it seems necessary to give the results of a large number of varieties which can be studied by individual farmers, in order that the greatest value from the experiments can be obtained. We are therefore presenting the average of five years' results in growing seventy-eight varieties of corn under uniform conditions. The varieties in this list are arranged according to the total yield of green corn per acre. For these experiments, the corn was usually planted during the last ten days of May and it was harvested about the middle of September. Immediately after the crop was cut, the ears were husked, weighed, counted, and examined. The stage of maturity of the corn was indicated by the condition of the grain at the time it was harvested. The seven terms which were used to describe the ripening of the corn at the time of husking were as follows: water, early milk, milk, late milk, dough, firm dough, and ripe. In each of the five years, the experiment was conducted in duplicate, and we therefore have ten distinct experiments conducted with all of these varieties within the five year period. The average results of the five years' experiments are given in the table on next page.

It will be seen from the results here presented that many of the varieties do not fully ripen at Guelph under the average conditions. In 1908, however, the corn matured unusually well at Guelph, a large number of the varieties producing ripened grain, although some of the large late varieties which are more suitable for the Southern States, never mature in this climate. As some of them are advertised, however, for growth in Ontario, it is well to have them included in the experiments so that the farmers will thus be enabled to see for themselves the comparison in stage of maturity, as well as in other respects, of the various corns grown in a locality which probably represents the average for the whole Province fairly well. When examining the results of experiments conducted at Guelph with the corn crop, it should be remembered that experiments have been carried on in a locality which is eleven hundred feet above the sea level and eight hundred and fifty feet above Lake Ontario, and in latitude north 43 degrees 38 minutes, also that Guelph is about thirty-eight miles inland from the lakes. Keeping these considerations in view, a large amount of valuable information can be gleaned from the figures presented in the table.

The results furnished in the tabulated form show us variations from 6.8 to 27.6 tons of green crop per acre, from less than 1 ton to 5.2 tons of husked ears per acre, from 2.7 to over 9 ounces in average weight per ear, from 55 to 134 inches in height of the total crop, and from 71 to 109 days from the time that the seed was planted until the crop was in full tassel. Between these extremes, we have a great many intermediate stages. In selecting a variety of corn for the silo, one should be chosen which furnishes not only a large total yield, but which is likely to reach a good stage of maturity in the locality where it is grown before the severe frosts appear in the autumn. From a study of the table, the superiority of one variety over another for any definite purpose is quite manifest. The reader can make many comparisons between the different varieties, and thus determine for himself the most promising kinds for him to test on his own farm, in order that he may find out the variety which will best meet his requirements. In the spring of each year, the Ontario Agricultural and Experimental Union distributes throughout Ontario seed for three experiments with corn: one with fodder corns, one with varieties of corn for husking, and the third with sweet corns for table use. As usually three leading varieties are distributed for each of these experiments, the farmers are thus enabled to ascertain for themselves which of the most promising varieties from the experiments conducted at Guelph will produce the most satisfactory results upon their individual farms.

VARIETIES OF CORN.

Varieties.	Description of varieties. Class of corn and color of grain.	Average number of rows per ear, 5 years.	Condition of grain when harvested.	Average results of five years' experiments. Number of days until in full tassel.	Height of plants.	Weight per ear.	Yield per acre. Husked ears.	Total crop green.
					in.	oz.	tons.	tons.
1. Pennsylvania Early Dent.	Yellow Dent..	20	Early Milk.	103	132	8.22	3.52	27.58
2. Pedrick Perfected Golden Beauty	Yellow Dent..	12-14	Early Milk.	103	130	6.35	2.78	27.15
3. Austin's Colossal Yellow Dent	Yellow Dent..	16	Early Milk.	103	134	5.84	2.34	26.57
4. Henderson's Eureka	Yellow Dent..	16-18	Early Milk.	101	130	9.21	4.00	25.86
5. New Century Wonder...	Flour	12	Water	109	119	2.87	.96	25.03
6. 100 Day Bristol	Yellow Dent..	14	Milk	99	126	7.53	3.70	24.83
7. Kansas Sunflower.......	Yellow Dent..	16	Early Milk.	102	129	5.62	2.83	24.39
8. Pride of Indiana	White Dent ..	16-18	Early Milk.	102	129	7.08	3.16	23.68
9. King of Illinois	Yellow Dent..	20	Early Milk.	102	129	7.54	3.12	23.47
10. Landreth's Large White Flint..............	White Flint ..	12	Early Milk.	101	129	5.97	2.92	23.42
11. Darke County Mammoth.	Yellow Dent..	18	Milk	96	121	9.50	4.44	22.22
12. Liberty	Yellow Dent..	16	Milk	96	121	8.28	3.92	21.79
13. Early Butler...........	Yellow Dent..	14-16	Milk	93	119	8.09	4.26	21.67
14. Cloud's Early Yellow ...	Yellow Dent..	20	Milk	99	123	8.79	3.77	21.59
15. Lenocher's Homestead ..	Colored Dent..	16	Milk	94	115	9.05	4.26	21.59
16. Salzer's North Dakota...	White Flint ..	8	Dough	88	100	6.81	4.36	21.26
17. Mastadon Dent	Yellow Dent..	18-20	Milk	97	121	8.84	3.87	21.21
18. Hoopengardner's Very Early Yellow Dent...	Yellow Dent..	16	Late Milk ..	89	111	10.47	5.17	20.93
19. Marblehead Mammoth..	Sweet	12-14	Milk	93	94	8.06	4.13	20.88
20. Snow White Dent.......	White Dent ..	16	Milk	97	118	8.10	3.76	20.82
21. Golden Combination....	Yellow Dent..	14-16	Milk	94	118	8.24	3.88	20.49
22. Reid's Yellow Dent	Yellow Dent..	16-18	Late Milk ..	94	117	9.02	4.18	20.42
23. Late Mammoth	Sweet	12-14	Milk	98	97	7.78	3.48	20.15
24. Golden Gate............	Yellow Dent..	16	Milk	94	116	7.98	3.64	20.12
25. Home-builder	Yellow Dent..	16	Milk	92	116	8.45	3.94	20.05
26. Golden Triumph........	Yellow Dent..	16	Milk	96	117	7.56	3.28	19.98
27. Lowe's Perfection	Sweet	12	Late Milk ..	88	90	7.91	4.76	19.88
28. Profit	Yellow Dent..	16-18	Milk	96	119	8.70	3.67	19.84
29. Improved Leaming......	Yellow Dent..	16-18	Milk	96	116	8.30	3.55	19.83
30. Mammoth Cuban	Yellow Dent..	16-18	Milk	92	114	8.14	3.94	19.82
31. Mammoth Southern Sweet	White Dent ..	14	Early Milk.	99	120	6.91	2.89	19.79
32. Indiana Wonder.........	Sweet	12	Late Milk ..	86	96	5.53	4.06	19.68
33. Wisconsin Earliest White Dent	White Dent ..	14-16	Milk	97	111	7.68	3.42	19.62
34. Stowell's Evergreen	Sweet	14-16	Milk	95	94	7.18	3.61	19.41
35. Rennie's Improved Leaming..................	Yellow Dent..	16-18	Milk	98	117	7.59	3.05	19.40
36. Rennie's Early Giant White Dent	White Dent ..	14-16	Milk	94	110	8.40	3.97	19.39
37. Wisconsin Yellow Dent..	Yellow Dent..	16-18	Milk	95	111	7.72	3.76	19.24
38. Compton's Early........	Yellow Flint..	12	Firm Dough	85	100	8.67	4.39	19.16
39. Country Gentleman.....	Sweet	.....	Milk	95	93	4.90	3 47	19.10
40. Potter's Excelsior	Sweet	12	Late Milk	91	88	5.72	4.07	19.05
41. Golden Era Dent........	Yellow Dent..	16	Late Milk ..	90	114	8.49	4.19	19.00
42. Early Mammoth.........	Sweet	12	Milk	94	93	7.82	4.01	18.95
43. Mayfield Earliest	White Dent ..	14-16	Late Milk .	90	112	9.25	4.20	18.95
44. King of the Earlies Dent.	Yellow Dent..	14-16	Late Milk ..	89	111	7.43	3.85	18.87
45. Longfellow	Yellow Flint..	8	Firm Dough	85	96	6.42	3.73	18.85
46. Tuscarora	Flour	8	Dough	87	91	7.34	4.30	18.84

VARIETIES OF CORN.—*Continued.*

Varieties.	Description of varieties.		Average results of five years' experiments.					
	Class of corn and color of grain.	Average number of rows per ear, 5 years.	Condition of grain when harvested.	Number of days until in full tassel.	Height of plants.	Weight per ear.	Yield per acre. Husked ears.	Yield per acre. *Total crop green.*
					in.	oz.	tons.	tons.
7. *Drought Proof Yellow Dent*	Yellow Dent..	16	Milk	90	114	8.01	3.84	18.82
8. Iowa Silver Mine........	White Dent ..	14-16	Early Milk.	97	116	7.91	3.58	18.65
9. Burlington Hybrid......	White Flint ..	8	Firm Dough	87	93	5.52	4.09	18.65
0. King Phillip...........	Colored Flint.	8	Ripe	83	98	6.67	4.07	18.31
1. Early White Cap Yellow *Dent*	*Yellow Dent..*	*16*	*Late Milk ..*	*92*	*110*	*8.25*	*3.65*	*17.76*
2. Canada Yellow..........	Yellow Flint..	8	Firm Dough	86	99	7.22	3.73	17.35
3. Hickox Sweet	Sweet	12	Milk	94	90	7.58	3.41	17.11
4. Clarke's Cuban Giant ...	White Dent..	16	Early Milk.	101	120	6.95	2.28	16.93
5. Pee and Kay	Sweet	12	Dough	83	80	6.92	4.51	16.71
6. Genesee Valley	Yellow Flint..	8	Ripe	81	96	7.42	3.51	16.43
7. Red Blazed.............	Colored Flint.	8	Ripe	81	96	7.40	3.95	16.41
8. *Wisconsin Beauty*.......	Sweet	12	Late Milk ..	86	80	8.45	4.67	16.35
9. University No. 13.......	Yellow Dent..	16	Firm Dough	83	103	8.69	4.40	16.06
0. Black Mexican..........	Sweet	8	Dough	89	83	4.57	3.91	15.54
1. Crosby	Sweet	12	Late Milk ..	83	80	6.03	4.02	15.53
2. Asylum	Sweet	12	Milk	96	89	7.26	3.01	15.26
3. Landreth's Sugar	Sweet	14	Milk	96	91	6.56	2.80	15.26
4. Early Windsor..........	Sweet	12	Dough	79	73	7.50	4.51	14.42
5. Perry's Hybrid	Sweet	12	Dough	82	79	7.96	4.07	14.42
6. Early Minnesota........	Sweet	8	Dough	80	72	5.48	3.77	13.89
7. Kendal's Early Giant ...	Sweet	12	Dough	81	73	7.53	4.45	13.82
8. Mammoth White Cory ..	Sweet	8	Dough	77	71	6.07	4.11	13.81
9. Farmer's Surprise.......	Yellow Flint..	8	Ripe	82	89	7.13	3.02	13.59
0. New Early Champion...	Sweet	12	Late Milk ..	92	79	7.06	3.31	13.17
1. Ford's Early............	Sweet	8	Dough	77	72	6.18	3.91	13.12
2. Premo	Sweet	10	Dough	77	66	5.31	4.12	13.04
3. Wisconsin Little Dent ...	Yellow Dent..	14	Firm Dough	76	95	8.50	4.09	12.98
4. Ringleader	Sweet	10	Dough	74	65	6.16	4.15	12.57
5. Farmer's Friend	Yellow Flint..	8	Ripe	78	74	6.01	2.86	11.81
6. Golden Bantam.........	Sweet	8	Dough	77	63	4.00	3.13	10.98
7. Malakhoff	Sweet	10-12	Firm Dough	71	55	2.65	2.76	8.81
8. Peep O'Day	Sweet	8-10	Dough	71	55	3.72	2.69	6.79

VARIETIES OF SORGHUM FOR FODDER.

Under the name of Sorghum we include a variety of crops such as Sugar Cane, Kaffir Corn, Millo Maize, etc. Some of these are used principally for the production of syrup, others for furnishing material for the manufacture of brooms and whisks, and others almost entirely for the production of food for culinary purposes. All of these classes, however, are more or less valuable for the production of fodder for farm stock. The Sorghums are grown quite extensively in some States of the American Union. They thrive well in a comparatively dry, hot climate, where the corn makes a slow growth. At the College none of the varieties have been used for silage and only one variety, the Early Amber Sugar Cane, has been used extensively for pasture purposes. For the production of fodder however, seventeen varieties have been under experiment. Of this number, eleven of the varieties have been

grown in each of five years from 1904 to 1908 inclusive. The seed was planted each year in squares by placing about five seeds in a place and allowing 3⅓ links (26 2/5 inches) between the different plantings. When the Sorghum was about five inches in height, some of the plants were removed, thus allowing only three plants to remain in each place. The Sorghum was cultivated in about the same way as corn. The following gives the height, the yield of heads, and the total yield of green crop per acre of each of eleven varieties, and for the average of five years.

Varieties.	Height.		Yield of heads per acre.		Total yield per acre.	
	1908.	Average 5 years, 1904-08.	1908.	Average 5 years, 1904-08.	1908.	Average 5 years, 1904-08.
	inches.	inches.	tons.	tons.	tons.	tons.
Orange Sugar Cane	110	109	.5	.6	21.5	23.2
Early Minnesota Sugar Cane	132	116	.8	1.2	24.4	19.9
Early Amber Sugar Cane	117	100	1.6	1.5	20.0	19.3
Kaffir Corn	69	74	.6	.8	14.5	14.9
California Golden Broom Corn	136	126	1.7	2.2	12.3	13.6
Early Japanese Broom Corn	134	119	2.0	2.2	13.5	12.7
Yellow Millo Maize	71	78	.8	1.0	8.6	11.7
Improved Evergreen Broom Corn	132	119	1.7	1.8	11.4	11.5
Australian Broom Corn	106	98	2.3	2.0	9.1	9.7
Brown Dhoura Corn	85	79	1.0	1.1	11.1	9.7
Jerusalem Corn	69	69	.6	1.0	5.1	6.9

In comparing the results from different varieties of Sorghum for the production of seed, given in the former portion of this report, it will be seen that the Broom Corns stood high in yield of seed per acre. In the results of Sorghums as grown for fodder crops, however, we find the Sugar Canes occupying the highest place in yield of green crops per acre. Of the different varieties of Sugar Cane in the experiment, the Early Minnesota gave the greatest yield per acre in 1908, but the Orange Sugar Cane furnished the largest amount of green fodder in the average results for five years. The Early Amber Sugar Cane is the best known variety throughout Ontario. Taking everything into consideration, it has given very good results indeed. The Kaffir Corn, regarding which we sometimes read extravagant statements in the newspapers, does not compare very favorably for growth in Ontario, with any of the varieties of Sugar Cane which we have had under experiment for at least five years. One variety of Kaffir Corn, however, the seed of which was obtained from the Rev. Mr. Grant, and which was sown in our experimental gounds in 1908 for the first time, is exceedingly promising. It grew very tall and the crop was quite uniform.

Varieties of Sunflowers for Fodder.

Considerable has been said regarding the advantages of using sunflower heads for mixing with corn, when filling the silo. It will be remembered by many, that Dr. J. W. Robertson strongly recommended the addition of horse beans and sunflower heads, to the corn for silage purposes. It was found, however, that the horse beans would not usually produce a satisfactory crop in Ontario, except in a few localities and in the more favourable years.

Sunflowers, however, thrive splendidly, producing large crops per acre. Seven varieties were grown in the Experimental Department for several years in succession, and careful notes were made regarding the productiveness and the growth of the different kinds. All the varieties have been discarded with the exception of the three which gave the most satisfactory results. Each of these three varieties has now been grown for thirteen years and the following represents the average yield in tons per acre, of heads, and of the whole crop of each of the three varieties: Black Giant 6.0 and 20.6: Mammoth Russian 5.7 and 16.8; White Beauty 5.8 and 16.4. The results of the White Beauty, however, are for eleven instead of thirteen years. The average results for the thirteen years also show the diameter of the heads and the height of the plants, to be as follows: Black Giant, 7.2 inches and 101.3 inches; Mammoth Russian, 7.5 inches and 94.7 inches; White Beauty, 7.5 inches and 86.4 inches.

VARIETIES OF MILLET FOR GREEN FODDER AND FOR HAY.

Millet is grown in Ontario to a limited extent, for the production of seed, green fodder, hay and pasture. It is probably used more as a catch crop than as a regular crop in the ordinary rotation. It sometimes occurs that owing to unfavourable weather conditions, farmers are unable to plant their corn until it is too late to insure satisfactory crops. When this occurs, millet can frequently be sown at a much later date with excellent results. For fodder purposes, seventeen varieties of millet were grown in 1908. This number has also been grown for five years, and fifteen of them have been grown for at least twelve years. The following table gives the results for 1908, and for the average of five years, in height, yield of green crop, and yield of hay per acre.

Varieties.	Height (ins.)		Tons per acre.			
			Green fodder.		Hay.	
	1908.	Average 5 years 1904-08.	1908.	Average 5 years 1904-08.	1908.	Average 5 years 1904-08.
Japanese Panicle	42	45	11.5	11.0	4.7	4.6
Holy Terror Gold Mine	35	34	9.7	9.0	3.9	3.7
Magic	38	36	8.9	8.6	3.8	3.5
Golden Wonder	36	36	9.2	8.9	3.4	3.5
Japanese Common	36	35	9.0	8.8	3.3	3.4
Steel Trust	33	35	9.0	8.8	3.1	3.2
Hungarian Grass	35	33	9.3	8.4	3.2	3.1
Japanese Barnyard	35	40	5.0	8.5	1.8	2.9
California	35	34	8.6	8.0	3.2	2.9
Siberian	36	35	8.4	7.8	2.8	2.9
Early Harvest	36	36	8.3	8.1	2.6	2.8
Common	36	34	8.1	7.4	2.5	2.7
German or Golden	37	34	8.4	7.7	2.9	2.7
Hog	34	37	7.6	7.2	2.2	2.5
White French	32	35	8.1	6.8	2.4	2.3
Red French	28	28	6.3	5.6	1.7	1.6
Early Fortune	25	24	5.7	4.7	1.1	1.4

The Japanese Panicle Millet occupies highest place in yield of both green crop and hay per acre in 1908, and in the average of five years. The Japanese Panicle is probably the most popular variety amongst the newer

sorts which have been tested by the farmers throughout Ontario. It grows to a good height, stands remarkably well, has a good leaf development, and is relished by farm stock. In those localities which are early enough for it to thoroughly ripen its seed, it also produces a good yield of seed per acre. There has evidently been a great misunderstanding amongst seedsmen as to the different varieties of Japanese Millet, as a number of the seedsmen in advertising the Japanese Millet, have illustrated Japanese Panicle, and have described the Japanese Barnyard Grass. These two varieties are entirely different. The writer understands that the farmers, in a number of cases, have obtained the seed of the Barnyard Grass instead of the Japanese Panicle Millet variety. The Japanese Panicle Millet has a dark reddish brown seed, which is very smooth and shiny, and is entirely distinct from the lighter coloured and different shaped seed of the Barnyard Grass.

Dates of Sowing Millet.

For three years in succession an experiment has been conducted in order to glean some information as to the best time to sow millet seed, for the production of green fodder and hay. For this experiment, the Japanese Panicle, the Japanese Barnyard and the Hungarian Grass were the varieties used. The first seeding took place on the 2nd of May in 1906 and in 1907, and on the 4th of May in 1908, and the succeeding seedings every half month, until in all, seven sowings were made. It is difficult to make hay out of the crops produced from the late seedings especially in the case of the Japanese Panicle variety. The following table is the average yield of green crop per acre, produced in 1906, 1907, and 1908, of each of the varieties, from the different dates of seeding.

Dates of seeding.	Average number of tons of green crop per acre.			
	Japanese Panicle.	Japanese Barnyard.	Hungarian Grass.	Average 3 varieties.
May 3rd	9.40	6.51	6.89	7.60
May 15th	9.71	7.57	7.16	8.15
June 1st	11.07	9.12	7.44	9.21
June 16th	10.27	7.60	7.24	8.37
July 1st	8.91	8.56	7.77	8.41
July 15th	8.83	6.83	7.79	7.82
August 1st			3.17	

From an examination of the results of this experiment, it seems to indicate that there is a possibility of sowing each of these varieties of millets, at either too early or too late a date, even in the growing season, if the most satisfactory returns are to be obtained. The highest average yield of green crop per acre was produced by the Japanese Panicle Millet when sown on the 1st of June; from the Japanese Barnyard Millet also when sown on the 1st of June; and from the Hungarian Grass when sown about the middle of July.

Varieties of Rape, Kale, Cabbage, Etc., as Farm Crops.

Of this class of crops, the best known throughout Ontario, is undoubtedly the Pasture Rape, and the variety in this class which is used almost exclusively, is the Dwarf Essex. Other somewhat similar crops such as the large feeding cabbage, the different kinds of kale, the cultivated mustards, etc., are not so well known and have been but little grown in Ontario. Some of these are used more extensively in Great Britain. Twenty-five varieties belonging

to this class of crops, have been under experiment for five years, and eleven varieties for nine years in succession. The crops have all been sown in rows 3⅓ links (26 2/5 inches) apart. Each plot was exactly one-hundredth of an acre in size, consisting of three rows each four rods in length. The seed was sown at the rate of about two pounds per acre. In order to give all varieties an equal chance, the plants in the rows were thinned to exactly two inches apart in every case. The land between the rows was cultivated occasionally throughout the early part of the growing season. The usual time of seeding has been about the middle of June. When the crops had reached about their best condition for feeding in the autumn, each variety was cut by the scythe and weighed in a green condition.

The crop is usually fed either to sheep or to hogs, and some times to young cattle. In England, the cabbage seed is frequently sown in the garden or in hot beds, and the young plants are transplanted in the field at sufficient distances apart to produce large heads of cabbage. This, however, requires a greater amount of labour, which is an important item in connection with agriculture in Ontario at the present time. In this experiment, the different varieties of cabbages have been treated in exactly the same way as the different varieties of rape and kale. The heads of cabbage have therefore been quite small, the growth being mostly leaf and stem. The quality, however, of these crops appears to be very good. The following table is the average results of this experiment:

Varieties.	Height (ins.)		Tons of green fodder per acre.		
	1908.	Average 5 years 1904-08.	1908.	Average 9 years 1900-08.	Average 5 years 1904-08.
Sutton's Earliest Drumhead Cabbage	23	19	20.8	24.4	27.8
Thousand Headed Kale	44	37	25.5	22.9	26.8
Sutton's Giant Drumhead Cabbage	22	21	27.6	....	26.7
Sutton's Earliest Sheep-fold Cabbage	19	18	27.3	20.8	25.6
Large Seeded Yellow Flowering Rape	38	30	24.6	....	24.2
Large Seeded Umbrella Rape	34	29	21.0	....	24.0
Large Seeded Common Rape	36	31	20.9	....	23.7
Marrow Collards	26	24	22.6	19.5	22.9
Sutton's Best-of-All Savoy Cabbage	17	18	21.5	19.0	22.3
Purple Sprouting Boroccoli	36	32	22.8	20.0	21.6
Dwarf Essex Rape	37	30	19.7	20.6	21.6
Dwarf Victoria Rape	32	29	19.1	20.8	21.4
Buckbee's Wonderful Dwarf Bonanza Rape	32	30	19.1	....	21.4
Large Seeded White Flowering Rape	34	31	18.7	....	21.0
Hardy Curled Kale	37	29	22.8	19.2	20.8
Cabbage Leaf Rape	39	33	21.1	....	20.6
Jersey Kale	40	33	24.0	18.5	20.6
Brussel's Sprouts	28	26	17.5	14.9	17.2
New Chinese Mustard	60	61	14.1	....	16.1
Bloomsdale Large Leafed Mustard	58	60	14.0	....	16.0
Southern Giant Curled Mustard	69	53	17.3	....	15.1
White Mustard	56	57	11.1	....	13.3
Creole Mustard	54	53	11.6	....	13.1
Brown Mustard	69	62	15.6	....	11.1
German Rape	11	26	5.1	....	5.7

The average of the five years' results show that of the four highest yielding varieties, three of them were cabbages. It will be seen that the Sutton's Earliest Drumhead Cabbage gave an average of 6.2 tons per acre per annum

very good record indeed. It should be remembered that the German Rape, as well as the different varieties of mustard, are annuals rather than biennials, thus coming into bloom in the same year in which the seed is sown, and are in this respect quite different from the other varieties included in the list here presented, which produce leaf and stem but not blossom, the first year. The cultivated varieties of mustard are sometimes sown in small quantities with the rape, in the Old Country. It is claimed that from this practice, there is not as great a liability of the sheep becoming bloated when pasturing on the crop.

The Leguminous Crops for Green Fodder.

In each of the past five years, eight different kinds of leguminous crops have been grown under similar conditions. These include Soy Beans, Vetches, and Cow Peas. Most of the varieties in each of these classes, require a fairly long season for growth and are more suitable for a warmer climate than that of Ontario. The following table gives the average results of this experiment for five years:

Varieties.	Average results for 5 years.	
	Height (ins.)	Tons of freshly cut crop per acre
Medium Green Soy Beans	32	8.1
Grass Peas	33	7.3
Ito San Soy Beans	26	7.1
Early Yellow Soy Beans	26	6.2
Wonderful Cow Peas	16	5.5
Whip-poor-will Cow Peas	14	4.8
Hairy Vetches	31	4.6
Red Ripper Cow Peas	14	4.5

The Hairy Vetches can either be sown in the autumn or in the spring of the year. Owing to the fact that a great deal of the seed of the Hairy Vetches is produced in Germany or other European countries, it makes the seed quite expensive, frequently costing $5 or $6 per bushel. The Early Yellow Soy Beans generally ripen early in Ontario, and yield from 16 to 18 bushels of grain per acre. The meal made from the Soy Beans, is exceedingly rich and considered to be equal to Cotton Seed Meal in this respect.

Alfalfa or Lucerne.

A bulletin on Alfalfa or Lucerne was issued in the spring of the present year. The bulletin covered information of experiments conducted at the Ontario Agricultural College, and dealt with the following subjects: Thirty Cuttings of Alfalfa in Ten Years; Varieties of Alfalfa; Inoculation; Soil, Seed and Seeding; Influence of Manures and Fertilizers on the Alfalfa Crop; Uses of Alfalfa; Quality of Alfalfa as a Feed; Influence of Alfalfa Roots on the Soil; and Alfalfa Grown in Combination with Grasses and Clovers. Copies of this bulletin can be obtained by writing to the Department of Agriculture, Toronto. The following gives information on Alfalfa growing at the College, with the results for 1908 included.

Thirty-three Cuttings of Alfalfa in Eleven Years.

The following table gives the yields per acre of the different cuttings of both green fodder and of cured hay of the Alfalfa crop, as produced in the

Experimental department of the Ontario Agricultural College in each of eleven years:

Years.	Green Crop (tons).					Hay (tons).				
	First Cutting	Second Cutting	Third Cutting	Fourth Cutting	Total.	First Cutting	Second Cutting	Third Cutting	Fourth Cutting	Total.
1896...........	9.96	6.47	4.06	2.06	22.55	3.08	1.91	1.29	.65	6.93
1897...........	12.04	5.61	4.43	....	22.08	3.59	1.56	1.23	....	6.38
1898...........	9.71	5.85	2.64	....	18.20	2.30	1.75	.63	....	4.68
1900...........	11.93	6.00	1.60	....	19.53	2.33	1.47	.80	....	4.60
1901...........	9.70	2.20	7.49	....	19.39	2.03	1.00	1.50	....	4.53
1902...........	13.35	8.69	2.96	....	25.00	2.50	2.02	.54	....	5.06
1903...........	13.10	8.53	2.75	....	24.38	2.50	2.09	.67	....	5.25
1904...........	12.45	9.35	4.00	....	25.80	3.40	2.50	1.08	....	6.98
1906...........	9.78	6.60	4.85	....	21.23	2.55	1.13	.58	....	4.26
1907...........	14.55	3.95	....	....	18.50	2.95	1.05	....	....	4.00
1908...........	9.70	6.75	3.73	....	20.18	2.50	1.15	.75	....	4.40
Average 11 yrs.	11.48	6.36	3.50	.19	21.53	2.70	1.60	.83	.06	5.19

The foregoing results were obtained from different seedings which took place in various parts of the experimental grounds, mostly in comparative tests with different varieties of clovers. In every case the crop was sown in the spring of the year, at the rate of eighteen or twenty pounds of Alfalfa seed per acre, and usually with a grain crop, such as barley, sown at the rate of one bushel per acre.

In each of nine years, the Alfalfa gave exactly three cuttings, but in 1907 it produced only two, while in 1896 it gave four cuttings in the one season. It will be remembered that the spring of 1896 opened up very early, and that of 1907 exceptionally late. In 1896 the first cutting took place on June 1st and the second cutting on July 2nd, but in 1907 the first crop was not ready to cut until the 2nd of July.

It will be seen that the annual yield of Alfalfa per acre per annum in the average of the eleven years' experiments was 21.5 tons of green crop and 5.2 tons of hay. Hence, green Alfalfa furnishes about 24 per cent., or practically one-quarter, of its own weight in the form of hay. The first gives about double the yield of the second cutting, and the second nearly double the yield of the third cutting. It is generally more difficult to make good hay from the third than from either the first or the second cutting, owing to the unfavorable weather conditions. Within the ten years here referred to, the Alfalfa produced more than six tons of hay per acre in each of three years, and less than four and one-half tons of hay per acre in each of two years. Since 1888, well established Alfalfa at the College has been badly winter-killed on only one occasion and partly winter-killed on two occasions. It has usually survived the winter and the early spring in excellent condition. Unfortunately, the results for 1899 and for 1905 were not recorded sufficiently in detail to permit of their being used in the foregoing table.

Varieties of Alfalfa.

There appear to be a few varieties of the wild forms of Alfalfa which are characterized by differences in the color and in the size of the flowers, in the coverings and in the structures of the pods, etc. Botanical authorities, however, have not made it clear that there are marked differences in the botanical structure of the Alfalfa which is used in cultivation. It is, nevertheless, true that the continuous growing of Alfalfa for long periods of time

in different countries under varying conditions of soil and climate has furnished numerous strains of varieties which vary in important characteristics, when considered from a practical standpoint. Different forms or strains of Alfalfa are known principally by the country in which they have been grown for a number of years. Even this is very indefinite, as for instance, there appear to be different strains of Alfalfa produced in Turkestan, the value of which varies considerably. Much has been claimed in the United States and in Canada for the Turkestan Alfalfa. The results of experiments which have been conducted at Guelph, however, within the past ten years, show that the so-called Turkestan Alfalfa obtained through the seed trade of the United States and Canada, has displayed no perceptible advantages over the common variety grown in this Province. Wishing to obtain fuller information regarding the best sources of purchasing Alfalfa seed of the highest quality for use in Ontario we secured for experimental purposes samples of seed grown in different parts of the world. Some of these were obtained through the kindness and co-operation of the Department of Agriculture at Washington, and some were obtained direct by the College. In the spring of 1905, twenty-eight plots were sown in duplicate with Alfalfa seed obtained from different sources. From each of the plots three cuttings for hay were made in 1906, one cutting for hay and one for seed in 1907, and three cuttings for hay in 1908. The following table gives the average dates of the first appearance of the bloom in the three years, and the total yield per acre of green crop and of hay from the three cuttings in 1906, the one cutting in 1907, and the three cuttings in 1908:

Source of Seed.	Dates of first bloom. Average 3 years.	Total yield per acre. Three cuttings in 1906. *One cutting in 1907 and three cuttings in 1908.	
		Green Crop.	Hay.
	June.	(Tons).	(Tons).
Texas, Panhandle	19	47.6	11.9
Nebraska	16	43.1	10.8
Turkestan, Khiva	20	43.2	10.7
Turkestan, Samarkand	20	42.0	10.4
Chinese Empire, Sairam	20	39.6	10.2
New York	15	41.5	10.0
Nebraska	21	39.6	9.9
Montana, Northern	19	36.8	9.8
Russia, Simbirsk	17	41.6	9.8
Montana, Southern	20	38.3	9.6
Montana, Northern	18	39.5	9.5
Germany	15	37.3	9.4
Texas, Sherman	17	38.2	9.4
Utah, Irrigated	20	37.2	9.2
France, Poitou	17	39.2	9.0
Colorado	19	35.0	8.6
Ontario, O.A.C. Seed, 1904	18	36.5	8.4
Kansas	22	30.6	8.2
Utah, Non-irrigated	17	30.9	7.9
United States, First Quality Commercial Seed	15	32.3	7.6
Ontario, O.A.C. Seed, 1903	19	31.1	7.4
Italy	16	31.5	7.1
Turkestan, through Wm. Rennie, Seedsman, Toronto	21	28.9	6.8
Russia, Kharkoff	15	29.6	6.7
Turkestan, through Currie Bros., Seedsmen, Milwaukee	16	26.1	5.5
France, Provence	19	24.4	5.5
Arabia	20	3.4	.8
Peru	....	.0	.0

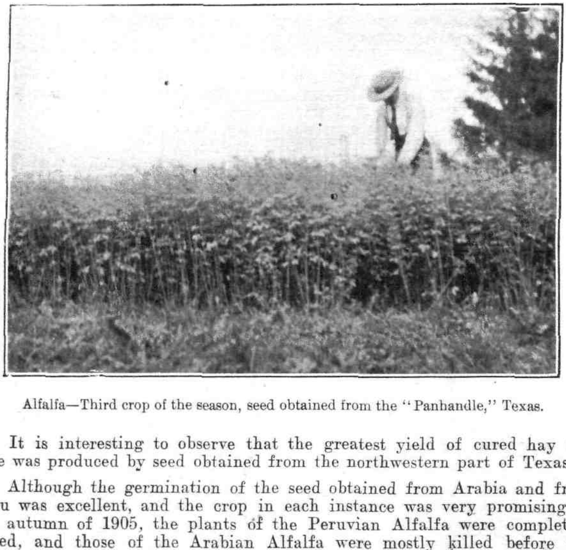
Examining individual plants of Alfalfa in the nursery plot.

Examining individual plants of oats in the nursery plot.

Testing weight per measured bushel.

It will be observed that the results obtained from the seed of the Turkestan Alfalfa which was obtained in America were decidedly lower than those obtained from the seed of the Turkestan Alfalfa obtained from Turkestan through the Department of Agriculture at Washington.

The plots which were sown in the spring of 1905 from seed produced at the College in 1904 and in 1903 gave quite similar results to the first quality of the commercial seed grown in the United States. It should be stated, however, that both the seasons of 1903 and 1904 were unfavourable in Ontario for the production of Alfalfa seed of average quality. It should also be taken into consideration that the seed produced in 1903 was over a year old when it was sown in the spring of 1905.

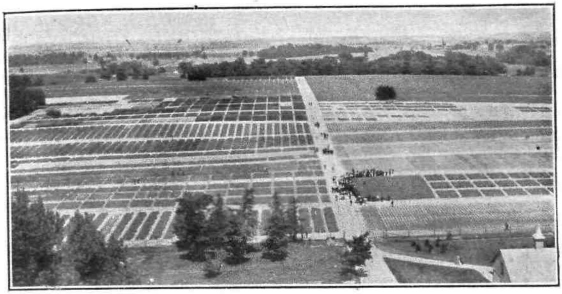


Alfalfa—Third crop of the season, seed obtained from the "Panhandle," Texas.

It is interesting to observe that the greatest yield of cured hay per acre was produced by seed obtained from the northwestern part of Texas.

Although the germination of the seed obtained from Arabia and from Peru was excellent, and the crop in each instance was very promising in the autumn of 1905, the plants of the Peruvian Alfalfa were completely killed, and those of the Arabian Alfalfa were mostly killed before the following summer. Both these strains of Alfalfa are giving particularly good results in the southwestern part of the United States, but owing to their acquired habits of growth prove to be exceptionally tender in Ontario.

In 1907, the second crop of Alfalfa, on each of the plots here referred to, was allowed to go to seeed. It was the desire to obtain seed of these different strains in order to continue the experiment, and to ascertain whether or not the seed obtained from the most productive kinds would continue to produce the best results. We hope that in time we shall be able to produce in Ontario a good supply of seed of the very best strains of Alfalfa.



Farmers viewing experimental plots.

Chinese Kaffir corn, 11½ feet high, on College trial grounds.

In the nursery plot of millet.

Sowing Alfalfa.

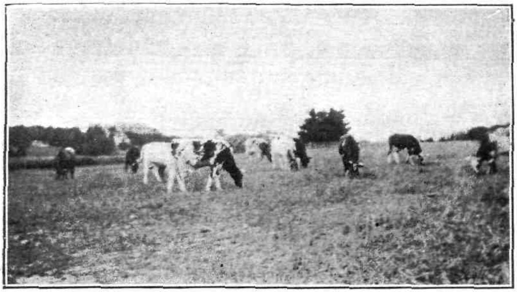
Alfalfa should be very carefully tested on many farms throughout Ontario. Its large yields of nutritious feed for farm stock, its perennial character of growth, and its beneficial influence on the soil, are all features which commend it very highly for those farms on which it can be grown successfully.

There are different ways of laying down a plot or a field to Alfalfa, and we would suggest the following method as one which is likely to give very excellent results. Select land having a clean, mellow, fertile surface soil overlying a deeply drained subsoil having no acidity. Use large, plump

Harvesting and making records of hybrid plants.

seed, free from impurities and strong in germinating power. Inoculate the seed with the proper kind of bacteria, providing Alfalfa has not been grown successfully on the land in recent years. As early in the spring as the land is dry enough and warm enough to be worked to good advantage, make a suitable seed-bed and immediately sow about twenty pounds of Alfalfa seed per acre from the grass seed box placed in front of the grain drill, and about one bushel of spring wheat or of barley per acre from the tubes of the drill. Smooth the land with a light harrow or with a weeder, and if it is very loose and rather dry, also roll it and again go over it with the harrow or the weeder. As soon as ripe, cut the grain and avoid leaving it on the land longer than necessary. Give the Alfalfa plants every opportunity to get a good start in the autumn in preparation for the winter. If for hay, cut each crop of Alfalfa in the following year as soon as it starts to bloom. In curing, try to retain as many of the leaves on the stems as possible, and to protect the crop from rain. Never cut or pasture Alfalfa sufficiently close to the ground to remove the crowns of the roots, and thus

injure or possibly kill the plants. If these directions are followed, the Alfalfa may be expected to produce large and valuable crops for a number of years without re-seeding.



Cattle feeding on the annual pasture crop.

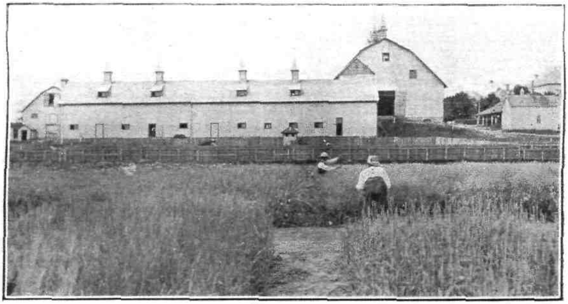
Spraying potatoes.

Annual Pasture Crops.

In experiments extending for several years, we have found that the following mixture has given very good results indeed, for sowing in the spring of the year for furnishing pasture for cattle, in the same season in which the seed was sown. Oats 51 lbs., Early Amber Sugar Cane 30 lbs.,

and Common Red Clover seed 7 lbs., making a total of 88 lbs. of seed per acre. This mixture, in each of the past three years, has furnished pasture which has been greatly relished by animals, and has furnished a sufficient amount of pasture material to supply fully one animal per acre.

Nursery plot of Soy Beans.



Measuring height of plots of oats.

We have on each occasion obtained a good catch of Red Clover, which formed a good matting on the ground in the autumn of the year, ready to come through the winter and furnish a crop of Clover in the following season.

Respectfully submitted,

C. A. ZAVITZ.

PART XVI.

LECTURER IN FORESTRY.

To the President of the Ontario Agricultural College.

SIR,—I have the honour to present herewith the report of the Forestry department for the year 1908.

The courses of lectures as outlined in the College Calendar have been delivered to the second and fourth year students. Lectures and field work were also carried on with the Nature Study students during the summer session.

COLLEGE WOODLOTS AND PLANTATIONS.

The principal work done in the woodlots this past season has been a small amount of thinning and improvement cutting with the filling of gaps by planting.

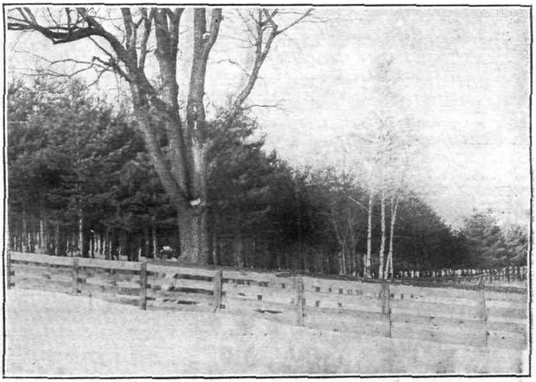


Fig. 1 illustrates a plantation of Scotch Pine made about twenty-five years ago. This was a gravelly hillside of small value for cultivation. At a very small cost it was replanted and to-day is a valuable asset to the farm. I use this illustration to again urge upon our people the advisability of replanting poor soils on the farm.

The open portions of the south woodlot have been filled with White Pine transplants; this work being a continuation of work started in 1907. As stated in my 1907 report this planting is being done in September and is partially an experiment in autumn planting. The planting done in the

fall of 1907 has thus far proven quite successful, and I feel quite assured that where sufficient protection exists September planting of evergreens will be quite practicable.

This may be of advantage, as many farmers will prefer to do this kind of work in the month of September rather than in April or May.

In some of the open portions of the south woodlot we have tried autumn planting of Black Walnut. This planting has been done by dibbling in the nut without removing the husk. About four bushels of nuts were planted in this woodlot and about eight bushels were planted in the north woodlot.

Besides the planting of open spots in the woodlot a new plantation has been made at the northwest corner of the farm.

This is a continuation of the north woodlot and is a parcel of land which is difficult to drain. Last summer (1907) it was summer fallowed and this summer it has been used as a temporary nursery. After lifting the nursery material this autumn it was planted up with White Pine and Black Locust. The White Pine were three year old transplants and the Black Locust one year old seedlings. The spacing used was five feet and three feet.

NURSERIES.

Our nursery work for the production of planting material has been the largest feature of the past season's undertakings.

Three different locations have been utilized to accommodate the growing demands of this work.

In the Holmwood nursery the following plants have been grown:

Tulip	(*Liriodendron tulipifera*)	2	year old *T.	825
Hardy Catalpa	(*Catalpa speciosa*)	2	" "	1,625
White Ash	(*Fraxinus americana*)	2	" "	3,875
Bitternut	(*Hicoria minima*)	2	" "	250
Box Elder	(*Acer negundo*)	2	" "	3,900
Black Cherry	(*Prunus serotina*)	2	" "	1,100
Norway Spruce	(*Picea excelsa*)	4	" "	4,500
Jack Pine	(*Pinus banksiana*)	2	" "	48,000
Scotch Pine	(*Pinus sylvestris*	2	" "	85,000
Riga Pine	(*Pinus sylvestris, var. Riga*)	2	" "	10,000
Arbor Vitae	(*Thuya occidentalis*)	3	" "	5,600
" "	(" ")	1	" "†S.	9,000
White Pine	(*Pinus strobus*)	4	" " T.	35,000
" "	(" ")	3	" "	140,000
" "	(" ")	2	" "	50,000
" "	(" ")	1	" " S.	135,000

In temporary grounds at the North Woodlot the following plants have been grown:

White Pine	(*Pinus strobus*)	3	year old T.	9,200
Norway Spruce	(*Picea excelsa*)	3	" "	50,000
Scotch Pine	(*Pinus sylvestris*)	3	" "	42,000

* T.—Transplants. † S.—Seedlings.

In the original nursery on the Macdonald grounds the following plants have been grown:

Tulip	(*Liriodendron tulipifera*)	2 year old	T.	650
"	(" ")	1 "	" S.	11,050
Chestnut	(*Castanea dentata*)	1 "	"	10,550
Burr Oak	(*Quercus macrocarpa*)	1 "	"	250
Horse Chestnut	(*Aesculus hippocastanum*)	1 "	"	210
Bitternut	(*Hicoria minima*)	1 "	"	550
Norway Spruce	(*Picea excelsa*)	4 "	" T.	21,000
White Ash	(*Fraxinus americana*)	2 "	"	200
Silver Maple	(*Acer saccharinum*)	1 "	" S.	2,000
White Ash	(*Fraxinus americana*)	1 "	"	3,780
Black Locust	(*Robinia pseudacacia*)	1 "	"	81,000
				766,115

Much of the above material is still small and has to remain longer in nursery lines. The greater part of this material has been shipped to the Norfolk County Nursery, which will be described elsewhere in this report.

Co-operative Planting.

This last season we have sent out about 375,000 plants for waste land reclamation. The material has consisted chiefly of White Pine, Scotch Pine, Norway Spruce, Jack Pine, White Ash, and Black Locust.

Owing to lack of assistance I have been unable to inspect plantations this last season and so can give no definite report as to results.

Through correspondence beginning to come in, I believe that last year's planting work has been largely successful.

Copy of Circular.

The following circular was printed and distributed during the year:

1. The Department of Agriculture of the Province of Ontario desires to assist farmers to improve their woodlots, and reforest waste portions of the farm. To accomplish this a system of co-operation is to be carried on as follows:

2. The Department, as far as the means at its disposal will permit, will assist in the *growing of a forest plantation or woodlot, by directing through one of its officers* as to preparation of soil, varieties to plant and manner of planting and as to care after planting.

3. The Department will also endeavor to furnish seedling trees or cuttings, as planting material, free of charge, but the person receiving such material shall pay the cost of transportation by express to nearest express office. Express charges on planting material for two acres will range from one to two dollars, at points one hundred miles from Guelph, depending on the kind of planting material.

4. *The Department advises that those undertaking waste land planting make a* start of one acre the first season. Two acres will be the largest area for which the Department will undertake to furnish planting material in any one year Larger areas *may be planted by arranging to continue the work through successive seasons.*

5. It shall be understood that the owner, on his part, must prepare the soil, plant and care for the trees, and do all the actual work in connection with the plantations,

in accordance with the directions of the officer of the Department. Prospective planters should read pages 19 to 32 of Farm Forestry, Bulletin 155, Ontario Department of Agriculture, which will give a more detailed idea of what waste land planting means.

6. The owner shall also agree to provide protection for the planted trees against animals by fencing or otherwise, and where necessary, against fire by some effective means.

7. The Department prefers to make plantations on such waste portions of the farm as steep hillsides, light sandy, rocky or gravelly spots, swamp land, portions of farm cut off by streams or otherwise. Such land can usually be profitably devoted to wood production if proper species are planted. However, in certain localities without woodlands it may be found advisable to plant on good agricultural soil, if the owner so desires. In cases were tillable land is to be planted, it will be advisable to summer fallow. Cultivation for one or two seasons after planting on good soils, where rank weed growth might follow, will be of great benefit to plantation.

8. It will be noticed that this system is co-operative in character. The Department furnishes planting material and expert advice, but does not guarantee to furnish any specific quantity of planting material. The Department reserves the right to accept or refuse applications if in the opinion of the officer in charge the location offered does not afford satisfactory facilities for the experimental and educational features of the work.

9. It is desired to make this work of educational value, and the owner will be required to allow public inspection of the planted areas, whenever this can be done without injury to other crops.

10. Attention is called to the fact that the Forestry Department furnish trees only for plantation work on waste land, or land which is undesirable to till for annual crops. No fruit trees, ornamental trees or shrubs, trees for town or village lots, Norway Spruce for hedges or windbreaks, will be supplied by this Department. As may be inferred from page 24 in Bulletin 155, the planting material sent out under this system is unfit for roadside or ornamental planting but is intended to make forest plantations.

11. Upon applying to the Forestry Department, Ontario Agricultural College, Guelph, the applicant will be furnished with a blank form for the purpose of describing the area it is proposed to plant, which should be carefully filled out and returned to the Department.

12. Applications coming in late in the spring may have to be held over for the following season's distribution.

Address all communications,

FORESTRY DEPARTMENT,

Ontario Agricultural College, Guelph, Ontario.

Collections of small forest trees have also been sent out to about seventy-five schools in the Province.

These collections were made up of the following: White Pine, Scotch Pine, Norway Spruce, Arbor Vitæ, White Ash, Black Walnut, Butternut and Tulip.

These seedlings have been placed in school gardens or other suitable locations and are expected to accomplish the following:

The students through handling and caring for these trees will come to know them.

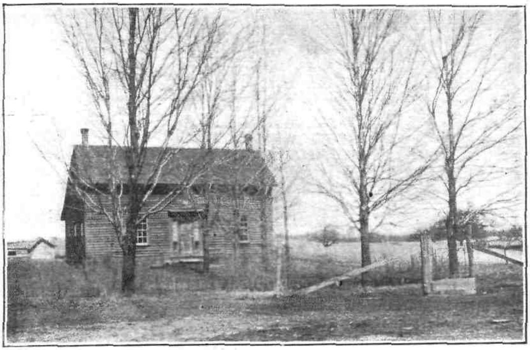
They can be transplanted when larger to portions of the school grounds or taken home by the children for planting about the home.

This work should give many children a more vital interest in trees, which in itself will repay the effort.

RECLAMATION OF NON-AGRICULTURAL LANDS.

As was intimated in last year's report (1907) there exists in old agricultural Ontario some few hundred square miles of unimproved lands which are only suited for forest crops.

This last year the policy of segregating and placing these lands under management has been inaugurated. One hundred acres of land has been purchased in the South Norfolk waste area and the nursery work at Guelph has been moved to this location. This land lies at the border of an area over 3,000 acres in extent.



In Figs. 2 and 3 are shown the buildings of the first farm bought. This property left the Crown in 1804 and comes back to it in 1908, a period of over 100 years. It has all been cleared with the exception of about 15 acres. This 15 acres is typical of the greater portion of the Walsingham Township waste lands. It is covered with Scrub Oak and scattered scrubby

White Pine. If protected from ground fires this would soon fill with White Pine. I wish to point out the fact that much of this type of land in the Province does not present so much a problem of replanting as of fire protection through proper management. The scattered scrub or defective White Pine which the lumbermen left are always endeavouring to reproduce, but every few seasons ground fires sweep over and kill the young Pine.

Management of this Norfolk forest station should embrace the following problems:

Nursery. The nursery work at Guelph is being moved to Norfolk because there is plenty of suitable soil available at a very low cost. In nursery management it is necessary to have a permanent staff of trained men. At Guelph it was difficult to find winter employment for these men. By managing the nursery in conjunction with the waste land problem winter work can be given with advanatage to both propositions as will be shown.

In the past we have been importing White Pine seedlings at a very low cost. I think that we shall now be able to produce White Pine planting material at a cost of very close to that of the German material.

We expect this year to put in about 100 lbs. of White Pine seed and also seed of Red or Norway Pine, Arbor Vitæ, Jack Pine, and various other species.

It is advisable to have government nurseries capable of producing planting material for the co-operative work with farmers and Public Schools. There is also developing a demand for planting material by corporations and private individuals on a larger scale than we have been able to supply through our co-operative work. As there are no commercial nurserymen meeting this demand it would be advisable to assist along this line. I would suggest that planting material be supplied at cost, as soon as possible, to such persons as desire to reforest waste areas on a larger scale than provided for in our plan as outlined in above circular.

Replanting. Wherever there is no chance of natural reproduction coming in, replanting work should be done. This planting should be of an experimental character determining cost, suitability of species, etc.

Improvement Cutting. As was previously pointed out much of this land will not require replanting.

It is covered with Scrub Oak with young Pine as an undergrowth. Wherever the soil is best suited to White Pine it will be advisable to cut the Oak and favour the Pine. All of the Oak cut can be taken out at a profit. Considerable of the material is of fence post size.

Wood Preservation. Considerable attention is now being given by various countries to preservative treatments for wood which comes into soil contact. It is found that the creosote treatment of a fence post adds from 6 to 10 cents to its cost but makes it from three to four times as durable.

It would be advisable to have a creosoting plant at this Norfolk County station and utilize much of the Scrub Oak in this way. From German experience it is found that such a post will last from 20 to 25 years in the ground.

Respectfully submitted,

E. J. ZAVITZ.

PART XVII.

THE LECTURER IN ECONOMICS.

To the President of the Ontario Agricultural College.

SIR,—I have the honour to submit herewith the report of the Department of Economics for 1908.

The courses of lectures as outlined in the College Calendar have been delivered to Second and Third year students. It has been found impracticable to hold a Fourth year class in Economics during the Fall Term. This is largely due to the fact that the largest section of the class,—the Agricultural Optionists—having to examine stock in different parts of the province, would be obliged to miss a large portion of the lectures given between October and Christmas. Arrangements have been made, however, for a lecture period with this class each week during the Winter Term. This, though altogether inadequate to meet the demands of men about to enter upon work, for the most part, of a public nature, should, nevertheless, prove very helpful.

The Sophomore and Junior Classes, in addition to the regular lecture work, are required to make simple economic investigations upon various subjects in different parts of the country. Subjects such as, "Farm Labour Conditions," "Co-operation," "Economic Comparisons of the Products of two or more Counties or Provinces," "Large *vs.* Small Scale Farming," "The Status of Particular Industries in Different Sections of Country," "The Agricultural Resources of Canada," "The British Embargo against Cattle," "Business Methods on the Farm," "Machinery in Agriculture," "Tenant Farming," "Immigration and Agriculture," "Government Aid to Agriculture," "Land Laws of Canada," "The Good Roads Problem," are among a very large number of questions which are being investigated. In all the work of this nature that has been attempted, I have pleasure in reporting that, almost without exception, it has been carried on in a most intelligent and creditable manner. Many of the papers are indeed worthy of a place on our library shelves. In all, the results of this phase of the Economic work have been sufficient to prove to my entire satisfaction that the class of students coming to this College are highly capable, with proper direction, of grappling with the most difficult economic problems of the day.

OUTSIDE WORK. During the months of May, June, July and August, it was my privilege, under the direction of the Deputy Minister of Agriculture, to commence an agricultural study of the Province from an economic point of view. The County of Lincoln, which was chosen as the first field of work, occupied the whole of my time during the four months. In fact a much longer period might have been devoted to this section to good advantage. The study was designed to cover such questions as the location and character of the different soils and crops grown upon them; methods of farming practiced, specialties, etc.; rotations most favoured; market and transportation facilities; methods of road-building and character of the roads; possibilities of developing certain industries such as, fruit produc-

tion, dairying and horse raising; land values, as indicated by prices obtained for farms recently sold; and other questions of a general nature having a bearing on agriculture. This work proved very attractive, and besides, has furnished me with a lot of most useful information. A full report of my investigations is being sent in another paper to the Department of Agriculture, Toronto.

ENGLISH. In addition to my regular economic work, I have been requested by the President and Professor Reynolds to take Second and Third Year in English Composition. This is by far the most onerous of my teaching work, and really requires a great deal more time than I have been able to devote to it. In no branch of their education are the students who come to this College weaker than in this subject. Consequently, unless endless pains are taken in the examination of their work and an enormous amount of practice afforded them, the Agricultural College must come face to face with the unique problem of graduating a class of semi-illiterate men.

Every week throughout the term the students of Second and Third Years have been required to hand in a short essay upon an assigned theme. These have been read, marked, and handed back with errors pointed out and means of improvement suggested from time to time. In this way great progress has been made, but a great deal still remains to be done.

In the opinion of the writer, we have reached a place where a man's whole energies might be devoted to good advantage to this subject.

Respectfully submitted,

H. H. LEDREW.

PART XVIII.

DIRECTOR OF HOME ECONOMICS.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to submit herewith the fifth annual report of the work of the Home Economics department, for the year 1908.

THE YEAR'S WORK.

The Home Economics department has been almost wholly occupied this year with the instruction of students, the majority of whom returned to their own homes to put their training into practice. No new courses have been opened, and only minor changes have been made in the old. The outstanding feature of the year is perhaps the rapid increase of long course students. The roll in September, 1907, showed sixty students entered for one and two-year courses, while September, 1908, showed eighty-seven.

THE DIFFERENT COURSES.

I. *The Normal Course.*

Eight entered the two-year course in September, 1906; four passed into the senior class in September, 1907, passed the final examinations in June, 1908, and have received the Macdonald Institute Teachers' Certificate in Domestic Science. Thirteen entered the course in 1907; twelve passed on to the senior class in September, 1908, and are now in attendance. Twenty students entered the junior class last September.

Six experienced teachers entered the one-year course in September, 1907; all passed the final examinations in June, 1908, and have received the Macdonald Institute Teacher's Certificate in Domestic Science. Another student without teacher's experience was allowed to take the work of this class in preparation for a special position, but was not granted the Macdonald Teacher Certificate. Last year we could have accepted more students; this year we were obliged to refuse several applications owing to the larger number coming forward from our junior class.

The Guelph Public and High Schools sent us four classes from January until June, for practice-teaching. The number was increased to five in September, because of the larger senior class.

No change has been made in this course during the past year.

2. *The Housekeeper Course.*

Four students entered this course in September, 1906; one dropped out shortly before completing the course in order to take a position, two dropped out in the third term on account of ill health, and one received the Macdonald Institute Housekeeper Certificate in June, 1908. Three entered the course.

in September, and two more were admitted in January, 1908; all passed on to the senior class in September, 1908. Two more entered the senior class (by virtue of Homemaker course work) in September, and six are now in attendance. Eight entered the junior class in September.

This course has been fully justified by results, and it is encouraging to note the increase in this year's class. For the benefit of capable and strong women who are looking for a new field of work we repeat the description of this course given last year.

This course is a professional one offered to mature women who have had a *good deal of housekeeping experience at home and desire training to fit* themselves for housekeepers or dietitians in larger institutions. They are expected to have good executive ability before entering; the course aims to give them correct standards in the preparation of food, housework, sanitation, etc.; and to train their executive ability along the lines of institution requirements. They are required to take the same science and practical work as the Normal students, but instead of studying school equipments and methods of teaching, they study methods of administration for large buildings such as our own residence for women. Each student is in turn required to act as marketwoman, loan clerk, and classroom housekeeper, doing the clerical work of each office. With Miss Tennant's assistance and instruction they investigate the working of Macdonald Hall. Part of this investigation consists of becoming a dining-room maid, a house-maid, and a kitchen-*maid for a short time in order to gain accurate and intimate knowledge of* the duties and difficulties of each position.

The graduates readily find employment, and several have been at work long enough to demonstrate their success. The demand for them is increasing rapidly, but we have no hope of meeting the demand at present. This is a pity, because the salaries offered are as good, and in many cases better than those of the average domestic science teacher. There are many capable women in the Province to whom this work should be attractive when they realize its possibilities. Two years of time, and three hundred and sixty dollars in money, seem a good deal to spend after a woman has reached mature years, but a comfortable income and a good home is worth the time and the money.

3. *The Homemaker Course.*

Twenty-eight entered this class in September, 1907; twelve passed the final examinations last June and have received the Macdonald Institute Homemaker diploma. Thirty-seven entered last September and are now in attendance.

The number who drop out of this course is very large, chiefly because many girls and many parents fail to realize that the course calls for a great deal of hard, earnest mental work as well as plenty of practical work.

The course is evidently a very attractive one. As usual we have had more applicants for it than could be accepted this year, and the prospect for next year is similar.

4. *The Short Course in Domestic Science.*

This course which is given three times each year, has crystallized into a very satisfactory practical course and is sufficiently elastic to fit most of the students taking it. There were in attendance this year in the Winter term, January to March, 48; Spring term, April to June, 21; Autumn term, September to December, 25; total, 94.

5. *The Short Course in Sewing.*

This new course, offered in the Spring and Autumn to meet the demand for a short course in sewing and allied subjects, has been satisfactory. Our staff can handle but one small class in the practical sewing work of this course, but so far it has met the demand. Its object is to do everything possible to help the girl who is anxious to learn to do the simple dressmaking required in the average home.

There were in attendance this year in the Spring term, April to June, 9; the Autumn term, September to December, 11; total, 20.

6. *The Summer Course in Domestic Science.*

Only eleven students entered this course last July. There is apparently no great demand for such a course in the Summer. This may be because for several years past every Normal School student in Ontario has had similar training, and few teachers of earlier training are sufficiently interested in the subjects to give up holidays for them. It may also be because there is no special inducement in the way of bonus or increased salary when the teacher returns to the school. It may also be due in part to the heat of July weather, which does not make cooking and sewing attractive to tired teachers. It must be said, however, that the teachers who formed this class were faithful students.

Special and Optional Students.

Two Normal graduates of 1908, and one Women's Institute lecturer, sought and obtained permission to spend three months at Macdonald Institute reading in our library on the subject of Dietetics.

Many of the optional students in the Spring term were students who dropped out of the Homemaker class for various reasons. These were required to fill up their time with classes, the rest were townspeople who took but one or two classes. There were in attendance for six months, 4; for three months, 23; total, 27.

Student Workers.

The arrangement by which a few girls are enabled to defray the cost of a short course by means of work instead of money is still carried on. This year nine girls have thus earned a three months' course in domestic science. They expressed themselves well satisfied with the arrangement.

Special Lectures, Meetings, etc.

The special marketing lectures were again carried out by College professors, and most of them were illustrated with numerous samples of the foods talked of. They were as follows: Vegetables, Mr. Crow; Fruit, Prof. Hutt; Canned Food, Prof. Edwards; Cereals, Prof. Harcourt; Meat Cuts, Prof. G. E. Day.

This department was represented at the Ontario Educational Association last April, and at the Lake Placid Conference held at Chautauqua, N.Y., last July, by myself. Miss Ferguson attended the Toronto Horticultural Show in November, in order to take part in judging the preserved fruit exhibit.

Mr. Putnam, Superintendent of Women's Institutes, held a two-day session with his Institute lecturers in Macdonald Institute last April, preparatory to their series of summer meetings.

Two sewing exhibits were held this year, one in June, while the summer excursionists were at the College, and the other in December, during the week of the Experimental Union and Women's Institute Convention. They excited much interest because the exhibits consisted only of work done by students of the sewing classes for one term, and gave a very fair idea of the work of our sewing department.

The pressure of class work which continues from September until the end of June is too great to permit of much experimental work. One series, however, was carried out for Prof. Harcourt, a report of which with his kind permission is inserted here.

REPORT OF EXPERIMENTS WITH SIX DIFFERENT FLOURS, TO DETERMINE WHETHER STRONG WHEAT OR SOFT WHEAT FLOUR IS BEST FOR MILK BISCUITS MADE WITH BAKING POWDER.

The flours used were obtained from the manufacturers for other purposes, but were regular brands which might have been bought in the open market, and were chosen as likely to yield decisive information. They were:

A. Strong—a high patent flour made wholly of Manitoba wheat.
B. Strong—a high patent flour made wholly of Manitoba wheat.
C. Soft—a nearly straight grade flour made wholly of Ontario wheat.
D. Blend—a combination of 20%B. strong and 80% C. soft.
E. Soft—an 85% soft wheat flour made wholly from Ontario wheat.
F. Soft—a 35% soft wheat flour made wholly from Ontario wheat.

The Macdonald Institute recipe for milk biscuits was taken as the starting point and a series of experiments carried out to determine various points before making the final test. In every baking each ingredient was carefully weighed, the biscuits compared with others, and results recorded to guide the procedure of the next experiment. When rolling out the dough before cutting the biscuits, flat sticks of equal thickness were laid on either side for the rolling-pin to travel upon, so that the biscuits of all bakings were as nearly alike in thickness before baking as was possible with dough of such slackness. Only the biscuits cut from the first rolling were baked, so that no biscuits were made from dough that had been worked over.

Experiment 1.

A batch of bakings with A. strong flour to decide what proportion of fat and baking powder, and what oven temperature yielded best results.

Baking No.	Flour.	Weight in grams of— Flour.	Fat.	Salt.	Bak. Pow.	Milk.	Dough.	Biscuits. Raw.	Biscuits. Baked	Oven Temp. Fr.	% loss in baking.	Remarks.
1.	A. Strong...	150	10	...	6	120	236	139	108	500	22	Oven too hot.
2.	A. "	150	12	....	6	120	288	136	115	400	15	Oven too slow.
3.	A. "	150	12	....	7	120	289	129	111	460	14	Very good.
4.	A. "	150	12	....	8	120	290	128	110	450	14	Excellent.
5.	A. "	150	12	·1	8	120	291	124	105	430	15	Very good.

Butter was the fat used in batches 1, 2, 3, 4, while lard with a little salt was used in 5. The flavour of 5 was not quite so good as that of the others. Had home-tried lard been available and a little more salt used, they would have been almost as good.

Conclusions: 12 grams. fat, 8 grams. baking powder and oven temperature of 450 gives best results.

Experiment 2.

A batch of bakings with B. strong flour to test above conclusions and help determine milk proportion. The idea being to secure dough of the same slackness with each flour.

Baking No.	Flour.	Weight in grams of—								Oven Temp. Fr.	% loss in baking.
		Flour.	Salt.	Bak. Pow.	Fat.	Milk.	Dough.	Biscuits.			
								Raw.	Baked		
6.	B. Strong.........	150	......	7	12	120	289	108	92	465	14
7.	B. "	150	......	7	12	120	289	119	97	400	18
8.	B. "	150	......	8	12	120	290	112	92	430	17
9.	B. "	150	1	8	12	120	290	118	99	430	16

Remarks: The dough of 6, 7, 8, and 9 was considerably slacker than of 1, 2, 3, 4, and 5. Lard with salt was used for 9, and butter for the others. Since home-tried lard was not available, it was decided to use butter as the fat for all succeeding bakings.

Conclusions: 150 grams flour, 12 grams butter, 8 grams baking powder, with an oven temperature of 450 gives best results.

Further tests necessary to determine proportion of milk for different flours.

Experiment 3.

A batch of bakings to determine the proportion of milk needed for each flour in order to have each dough of the same slackness.

Baking No.	Flour.	Weight in grams of							Oven temp. Fr.	Per cent. loss in baking.	Remarks.
		Flour.	Butter.	Bak. Pow.	Milk.	Dough.	Biscuits.				
							Raw.	Baked			
10.	A. Strong...	150	12	8	135	305	122	94	450	23	Too slack.
11.	B. " ...	150	12	8	125	295	118	97	450	17	A trifle stiff.
12.	B. " ...	150	12	8	130	300	117	96	450	18	A trifle slack
13.	A. " ...	150	12	8	130	300	130	105	450	19	Excellent.
14.	C. Soft......	150	12	8	118	288	112	89	450	20	A trifle slack
15.	D. Blend....	150	12	8	119	289	111	94	450	15	....
16.	E. 85% soft.	150	12	8	114	284	107	87	450	18	A trifle slack
17.	F. 35% " .	150	12	8	111	281	120	101	450	15	A trifle stiff.

Conclusions: To test the flours further with a larger quantity of flour, proportioning milk in accordance with above remarks. Also to notice what might be called the "handling" quality of each dough when all are of uniform slackness. Weak flour seems easier to handle in a soft dough than a strong flour dough which is very sticky when made very slack.

Experiment 4.

A batch of baking with the quantities of ingredients doubled, in order to further test the proportion of milk necessary.

Baking No.	Flour.	Weight in grams of							Oven temp. Fr.	Per cent loss in baking.	Remarks.
		Flour.	Butter.	Bak. Pow.	Milk.	Dough.	Biscuits. Raw.	Biscuits. Baked			
18.	A. Strong...	300	24	16	260	600	457	393	450	14	Too slack.
19.	B. " ...	300	24	16	256	596	444	397	450	10	" "
20.	C. Soft......	300	24	16	232	572	445	403	450	14	Right.
21.	D. Blend....	300	24	16	Reco	rd des	troyed	by acc	ident		Try 221 gram's milk.
22.	F. 35% soft..	300	24	16	218	558	431	389	450	9	Same as 20.
23.	E. 85% " ..	300	24	16	222	562	435	Reco	rd des	tr'd	Same as 20.

Remarks: It was necessary to obtain a fresh stock of C. soft flour before lot 21 was made. Experiment showed it weaker than that first used.

Conclusion: The doubling of quantities and baking in quick succession showed necessity of further modification of milk proportion.

Experiment 5.

A final batch of bakings. The ingredients for each batch (except the milk) were weighed and kept carefully separate before any mixing was done. The mixing and baking were done as rapidly as possible. Nine biscuits of each flour were baked, when sufficiently cooled the best six of each were numbered and placed in a covered wooden box to prevent drying out before they were judged.

Baking No.	Flour.	Weight in grams of							Oven temp. Fr.	Per cent. loss in baking.
		Flour.	Butter.	Bak. Pow.	Milk.	Dough.	Biscuits. Raw.	Biscuits. Baked		
24.	A. Strong	300	24	16	252	592	308	257	450	16
25.	B. "	300	24	16	248	588	307	257	450	16
26.	C. Soft	300	24	16	212	552	323	260	450	19
27.	D. Blend	300	24	16	221	561	306	259	430	15
28.	E. 85% soft............	300	24	16	222	562	302	257	450	14
29.	F. 35% "	300	24	16	218	558	295	247	450	16

Remarks: When strong and weak flours are made slack enough for biscuits and both are of the same slackness, the difference in "handling" quality is very noticeable. The strong flour dough has a stickiness like glue, while the soft flour has a silky smoothness which is much easier to handle.

When baked these biscuits are much alike in general appearance owing to the care taken in proportioning ingredients, maintaining oven temperature, and in manipulation; but the experimenter judged the first two about equal, C. soft rather better, 85% decidedly best, with 35% a close second.

The Dominion Millers' district meeting was held in Guelph, December 12th, 1907. One session was held in the O. A. C. Chemical Building about twelve hours after the biscuits were finished. All the numbered biscuits were carried over, the meeting informed of the uniformity of manipulation, quantities of flour, fat and baking powder, but not told the names of the flours or quantities of milk used, and the meeting asked to judge which were best. A committee of three was appointed, which reported numbers 28, and 29, as best, but declined to rank one above the other. The committee stated there was so little difference between the other lots that judgment between them was very difficult.

Conclusion: Soft wheat flours yield the tenderest biscuits when conditions are uniform.

Comparison of Cost.

The time of baking in the final experiment was about ten minutes for each lot, except lot 27, which took twelve minutes, but no exact record was kept. This calculation is therefore based upon the cost of raw materials only.

Cost of	A. Strong.	B. Strong.	C. Soft.	D. Blend, 20% B. 80% C.	E. 85% Soft.	F. 35% Soft.
Flour per cwt.	$3.20	$3.15	$2.10	$2.31	$2.50	$2.80
Butter, lb.	.30	.30	.30	.30	.30	.30
Baking powder, lb.	.53⅓	.53⅓	.53⅓	.53⅓	.53⅓	.53⅓
Milk, qt.	.04	.04	.04	.04	.04	.04
Flour used	.02119	.02086	.01390	.01529	.01655	.01854
Butter "	.01589	.01589	.01589	.01589	.01589	.01589
Baking Powder used	.01884	.01884	.01884	.01884	.01884	.01884
Milk used	.00931	.00916	.00783	.00816	.00820	.00805
Total cost material	.06543	.06475	.05646	.05811	.05948	.06132
Weight raw material (grs.)	592	588	552	561	562	558
Cost per lb.	.05006	.04988	.04633	.04692	.04794	.04977

Summary.

1. Other things being equal, soft wheat flours make tenderer milk biscuits than strong wheat flour.

2. Given a strong wheat flour dough and a soft wheat flour dough of equal slackness and suitable for milk biscuits, the soft wheat flour dough is the easier to handle.

3. At the present prices of the different flours the strong wheat flour biscuits cost more than soft wheat flour biscuits.

4. It is possible that a larger proportion of fat used with the strong wheat flour would yield biscuits of tenderness equal to those of soft wheat flour, but the cost of fat makes that method of improvement a disadvantage.

RECIPIENTS OF TEACHERS' CERTIFICATE IN DOMESTIC SCIENCE.

A.—Graduates of the Two-year Normal Class :

Miss Irene Isabel Allan, Regina, Sask.
" Minnie Kent, Delhi, Ont.
Miss Eleanor Robertson, Toronto, Ont.
" Kathleen Vaughan, Brantford, Ont.

B.—Graduates of the One-year Normal Class :

Miss Arabella Bligh, Lakeville, N.S.
" Mary Helen Clowes, Toronto, Ont.
" Jennie Doak, Hamilton, Ont.
Miss Mildred R. McKee, Brandon, Man.
" Mossie B. Shepherd, Toronto, Ont.
" Christina L. Smyth, Toronto, Ont.

Recipients of the Housekeeper Certificate.

Miss Ada Hobbs, Guelph, Ont.
Miss Elizabeth Warner, Coulson, Ont.

Recipients of the Homemaker Diploma :

Miss Jean M. Casey, Toronto, Ont.
" Marjorie Clark, Woodstock, Ont.
" Maud Davison, Cannington, Ont.
" Isabella Garland, Ottawa, Ont.
" Mary Hanna, Toronto, Ont.
" Molly Mungall, Milltown, N.B.
Miss Jessie B. Murray, Avening, Ont.
" Gladys Newberry, Hamilton, Ont.
" Barbara Palmer, Woodstock, Ont.
" Eva Tweddle, Fruitland, Ont.
" Lillian Wyckoff, Tyrrell, Ont.

SUMMARY OF ATTENDANCE.

A.—January to June, completing the College year of 1907-1908.	
Normal Students :	23
Two Year Seniors, 4 ; One Year Seniors, 6 ; Juniors, 13.	
Housekeeper Students :	9
Seniors, 4 ; Juniors, 5.	
Homemaker Students ;	24
One Year, 21 ; Two Year, 3.	
Short Course in Domestic Science :	69
Winter Term, 48 ; Spring Term, 21.	
Short Course in Sewing (Held in Spring Term only)	9
Optional Students :	23
Six Months, 4 ; Three Months, 19.	
Public and High School Students :	72
B.—Summer Course in Domestic Science	12
C.—September to December, opening the College Year of 1908-1909.	
Normal Students :	37
Two Year Seniors, 12 ; One Year Seniors, 5 ; Juniors, 20.	
Housekeeper Students :	15
Seniors, 7 ; Juniors, 8.	
Homemaker Students :	37
Two Year, 5 ; One Year, 32.	
Short Course in Domestic Science	25
Short Course in Sewing	11
Special Students in Dietetics	3
Optional Students	4
Public and High School Class Students	68
Total	441
D.—Students counted on both lists :	
In Two Year Courses,	14
In Public and High School Classes	13
Total	27
E.—Total Number of Students in 1908	414
F.—Increase in attendance over 1907	47

STAFF CHANGES.

Miss Givin was absent from January until June owing to illness. During her absence Miss Allan took the bulk of her classes, and Miss Ethel Gromitt, a graduate of an English school, took Miss Allan's work in Laundry.

Owing to the increasing pressure of students in September, Miss Nealina Macmillan was engaged to supervise the house-practice work. The work is now well looked after and we hope the arrangement will become a permanent one.

EQUIPMENT, ETC.

Up to September last the house-practice work had no headquarters. As the students increased and the kitchens and laundry were seldom out of use, this became very inconvenient. We have now gathered all the necessary apparatus into one of the rooms vacated by the Manual Training department and installed a couple of laundry tubs there. The irritating congestion of the other rooms is relieved, and the work runs smoothly.

The new automatic clock is a great addition to our equipment. It rings all bells needed for changing classes, assemblies, meal hours, etc., and needs no attention from anyone.

Macdonald Institute, with little more equipment, can accommodate many more students than at present. Greatly increased attendance, however, cannot be expected until Macdonald Hall is enlarged. Few parents wish their young daughters to board down town. Several applications were refused on this account last January; more were turned away in September; and by November tenth every room in Macdonald Hall was engaged for next January, in spite of the fact that foreign and optional students were ruled out.

Reference to the summary of attendance shows that the number of long course students is steadily increasing. It would therefore seem wise to begin thinking about and planning for extension of the residence building. Present conditions indicate that it will be needed long before it is accomplished.

I beg to acknowledge the efficient work of the other members of the Home Economics staff, and the valuable help given this department by many of the other departments.

MARY URIE WATSON.

PART XIX.

THE PROFESSOR OF FARM MECHANICS AND MANUAL TRAINING.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to present herewith my fifth annual report on the work of the department of Farm Mechanics and Manual Training, for the year 1908.

Since making my last report I have had the opportunity of attending a convention of the professors and instructors in farm mechanics and agricultural engineering in the leading Agricultural Colleges of the United States. This, their first convention, was held on December 27th and 28th, at Madison, Wis., in the building of Farm Mechanics of the University. The deliberations on how to improve and carry on this work proved useful and profitable. The first meeting was devoted to the formation of a permanent organization, and representatives from various colleges in the Union were elected to put the constitution in operation. The next convention is to be held during the winter vacation at Urbana, Illinois, when I hope I shall again have the pleasure of attending. These conventions cannot help but prove of great service to those engaged in the teaching of this subject. The following papers were read and discussed:—

"The Courses of Agricultural Engineering That Should be Offered," by Prof. Howard W. Riley, of Cornell.

"Shop Courses for Agricultural Students," by Prof. Wm. Boss, of Minnesota.

"Instruction in the Use of Cement and Concrete," by Prof. Ocock, of Wisconsin.

"Instruction in Farm Machinery," by Prof. L. W. Chase, of Nebraska.

"Teaching a Course in Farm Motors," by Prof. Rose, of North Dakota.

"A Course in Rural Architecture on Farm Buildings," by Prof. F. R. Crane, of Illinois.

"Agricultural Literature," by Prof. W. M. Hummell, of Colorado.

Addresses were also given by B. B. Clarke, editor of the *American Thresherman and Gas Review*, Madison, on "The Importance of Traction Engineers Having Proper Education," and by R. R. Teele, of the Department of Agriculture, Washington, D.C., on "Irrigation Drainage Investigations."

INSTRUCTION.

Winter Term. Commencing with the Winter Term of 1908, we had 120 First Year students in Woodworking and Drawing. This large number necessitated a division into six classes. It is to be noted here that this division reduces the time to three hours per week in the combined subjects. When it is stated that the students of these subjects in the States spend from 50 to 60 hours per term in these branches, as compared with our 39 per term, it will be readily admitted that we are labouring under some disadvantages. It is to be wished that facilities can be discovered by which more

time could be devoted to the subjects, especially when it has to be given up at the time when the student is beginning to receive the greatest benefit and to see its application to his life work.

Spring Term. Eighteen students taking the Household Science Course at the Macdonald Institute were given instruction in Applied Art in Wood and Metal work to amplify the courses given at the Institute. During the spring term sixteen pupils attended the various Optional Courses. In addition to these, eleven students were given lectures and practical demonstrations in Color and Household Decorations.

Summer School. By arrangement with the Education Department, a Summer School for Public School teachers was held from July 2nd to 27th. The following courses were offered:—

Course I.—Cardboard and Art.

Course II.—Woodworking.

For Constructive Work and Art, eight students registered. In Woodworking and allied subjects, nine were enrolled. These were:—

Course I:

Burke, Miss A. M., Belleville.	James, Miss Ada, Belleville.
Dickinson, Miss F. L., Toronto.	Smith, Miss L. E., Brantford.
Fair, Miss Becca, Millbrook.	Parsons, Miss Marion, Goderich.
Fee, Miss Henrietta, St. Catharines.	English, Miss Edith, Kingston.

Course II:

Chambers, J. E., Guelph.	McConnell, E. D., Bancroft.
Flumerfelt, W. M., Guelph.	Wilcox, A. E., Stoney Creek.
Ingram, H. L., Belleville.	Hutton, A. E., Edmonton, Alta.
Long, Miss M., Brantford.	Slaughter, J., Toronto.
Plummer, Miss M., Wabash, Ind.	

The instruction in Art and Constructive Work was given by Miss Jennie Grier, of Port Arthur, a former student of Macdonald Institute. Attending this class were also twenty-six students from the Nature Study Course.

FARM CARPENTRY. Instruction was given to thirteen students taking the course in Elementary Agriculture.

Fall Term. The fall term opened with ninety Second Year boys taking bench-work in metal, forging, farm mechanics. These were formed into three divisions and we were most ably assisted by Mr. R. W. Wade, B.S.A., Lecturer in Animal Husbandry, and occasionally by Mr. Douglass, Farm foreman.

We consider this subject of the greatest import in the education of the future farmer, and the utmost care is taken in arranging laboratory exercises, in order that the vital points of each machine may be thoroughly understood. If a student has this knowledge, much time may be often saved by being able to carry out small repairs and to secure the effective working of the machine. Laboratory sheets are prepared, dealing with each implement and machine, of which the following are typical:—

Cultivator.

(a) 1. Name of cultivator? 2. Manufacturer's name?
3. Where made? 4. Price? 5. Single or double row?
6. Riding, walking, or combined?
7. Has the cultivator an expanding axle?
8. If so, how is the width changed?
9. What is the narrowest and widest width (centre of tire to centre of tire)?
10. Can axle be reversed?
11. Is the change difficult or hard to make?
12. How are the rigs spread?
13. Are the shovels straight or curved?

14. Are the couplings of the beans flexible and yet without lost motion?
15. Is there any provision for taking up the wear in the couplings?
16. Are you aided in lifting the rigs by a spring?
17. If so, where is the life spring located?
18. Can the tension of this spring be varied?
19. Does spring release when gang is up?
20. Will the spring hold the shovels in the ground?
21. Is the balancing automatic, by lever, or by gears?
22. Can the lifting lever be easily worked from the seat?
23. Can the rigs be forced into the ground?
24. Has the cultivator pivotal wheels?
25. What is the height of wheels?
26. What is the width of tire?
27. What is the shape of section of tire?
28. Have the wheels closed wheel boxes?
29. Have the wheels hard oilers?
30. If the cultivator has a seat what kind is it (hammock or straddle)?
31. Is it adjustable as to height and position?
32. Has the cultivator a spread arch?
33. Are singletrees attached so that pull carries tongue?
34. How are the rigs shifted?
35. Can the rigs be raised independent of each other?
36. If two rows, how is the adjustment made for width of row?
37. Will cultivator pass over large corn?
38. How is the height of hitch regulated?
39. Has the cultivator a foot pedal for guiding?
40. Has the cultivator a foot lift?
41. How far is it from the hitch back to the front shovel?
42. How much clearance do you find under the beams?
43. How is the pitch of the shovels regulated?
44. What is the distance between the shovels?
45. Can you change the number of shovels without changing the rigs?
46. What kind of shields has the cultivator?
47. Can the shields be combined in any way?

(b) 1. Why are inside shovels in front?

2. Can you cultivate nearer end of rows with pivotal cultivator than with the stiff one?

3. Explain your answer.

Sulky or Gang Plow.

(a) 1. Name of plow? 2. Manufacturer's name? 3. Where made?

4. Price? 5. Size? 6. Class of bottom (breaker, general purpose or stubble)?

7. Is the plow a high lift?

8. Frame or frameless? 9. Tongue or tongueless?

10. Is the plow drawn from beam or frame?
11. Has the plow a foot life?
12. Can the plow be made to float on stony ground?
13. Have the wheels enclosed wheel boxes?
14. Have the wheels hard rollers?
15. Are the wheels handy for greasing?
16. What is the height of hitch above floor, plow on floor?
17. Put a straight edge along the landside, and measure how far the furrow wheel is set over.
18. Has the plow any provision for adjusting the amount the rear wheel is set over.
19. Measure how much the keel of the landside lacks of touching the floor when the point of the share is on the floor and wheels are blocked up to the depth of the furrow.
20. Has the plow any provision for adjusting the amount of suction?
21. How high will the plow lift?
22. *Will the plow make as good a right hand corner as a left hand?*
23. On what side of shin is reinforcement?
24. Do wheels have boxings?
25. Does frame seem to be heavy or light as compared to other frames?
26. Can landside be removed?

(b) 1. What are the bails of a plow?

2. What is meant by load in the wheels?

3. Why are the furrow wheels inclined?

4. Why are the rear furrow wheels set outside of the line of the landside?
5. Should landside bear against earth as plow passes along?
6. How far should a rolling coulter be set outside the line of the landside?
7. By how much should a rolling coulter clear the shin of the plow?
8. What is the best plow in your estimation? Why?

Manure Spreader.

(*a*) 1. Name of spreader? 2. Manufacturer's name?
3. Where made? 4. Do the wheels track?
5. What advantages in a short front axle?
6. What advantages in a long front axle?
7. Will front wheels turn under bed?
8. *Are front trucks well fastened?*
9. Has machine an endless apron?
10. If return apron, does it return by hand or power?
11. Will cylinder clean apron thoroughly?
12. What system of mechanism is there for driving the apron?
13. How is the apron carried?
14. What device is there for breaking chunks?
15. Where is this device located with regard to cylinder?
16. How many levers has the machine?
17. Where is the lever for throwing the cylinder into gear located?
18. Where is the apron lever located?
19. If there is a reverse lever, where is it located?
20. Is the apron, chain or gear drive?
21. Is the cylinder chain or gear drive?
22. Where is cylinder in and out gearing located?
23. Is it accessible for repairs?
24. What is the style of mechanism for changing the speed of apron?
25. Can the feed be thrown out of gear and still permit the cylinder to run?
26. What is the shape of the cylinder teeth?
27. Will the machine spread wider than the bed?
28. What is height of bed?
29. What is height of driving wheels?
30. What is width of tire on same?
31. Does cylinder throw fertilizer over or under?
32. *Which moves horizontally, cylinder or apron?*
33. Which do you say will have the lightest draft, a machine moving the load to cylinder, or one moving cylinder to load?
34. Is there a drill attachment?

During this term thirteen pupils from Macdonald Institute attended the Course in simple Carpentry and eleven were present in the Colour Work.

ADDRESSES AND WRITINGS.

In the course of the year the following articles were prepared by me for the Press at request of the editors:—

O. A. C. Review, "Future Power of the Farm."

O. A. C. Review, "Conditions Governing Location of Farm Buildings."

Canadian Dairyman and Farmer, "Choosing a Farm Power."

Canadian Thresherman and Farmer, "Power on the Farm."

I also addressed the convention of the teachers of Victoria County in the Woodworking Room of Machinery Hall on "Relation of the Grade Teacher to Handwork."

I attended the Convention of the teachers of Waterloo County, held at the Collegiate Institute, in Berlin, and spoke on "Educational Values of Handwork."

Mr. Kendall contributed an article to the *O. A. C. Review* on "Farm Workshop."

Choosing a Farm Power.

In view of the growing interest in farm power, I give the text of the article on "Choosing a Farm Power."

In the daily round and common task of the farmer, much of the hard routine work now done by manual labor could be as efficiently and economically performed by some mechanical contrivance, as by sheer brute force of the hired man. Now that high price labour is scarce and extremely difficult to secure, every thoughtful farmer is contemplating how best to meet the situation so as to release somewhat the tension and strain of the strenuous life of the present day on the farm. Naturally his thoughts turn in the direction of installing some mechanical equipment to perform the heavy humdrum work, and the question that troubles him sorely is what is the best "rig" to instal to advantage, not only at the pump or feed grinder, but also at the wash-tub, churn and separator. To the average farmer who is forced by circumstances to contemplate something seriously along this line, and who has had comparatively little or no opportunity of seeing the different kinds of motive power, and the methods generally adopted to apply them to all sorts of farm operations, the problems of selecting the right mechanical outfit which will meet all his requirements most satisfactorily, is a vital and a perplexing one.

There are two types of engines on the market—the two-stroke cycle and the four-stroke cycle. The operations taking place in the cylinder to produce continuous power are similar in principle and character in each type and effect the same results, but the method of control is different. In a two-cycle engine there is an impulse or explosion for every second stroke of the piston, while the four cycle has four single strokes of the piston for every explosion. It is evident that given the same size, weight and strength of engine parts the engine operating with the greatest proportion of working strokes will develop the most power, so that the two cycle engine has a decided advantage on this score, but owing to its later development and its various mechanical difficulties yet to be overcome, it has not met with success like the four cycle principle, which better meets the requirements of power users, and manufacturers do not care to leave a ready market to perfect the two cycle problem. One of the weighty points for consideration is the horse power of the engine most suitable for farm work, but different localities are engaged in widely different kinds of farming. It is therefore impossible to arbitrarily say that a certain horse power will adequately meet all demands, say, of a hundred acre farm. The work to be done by the engine, of course, depends entirely upon the size and capacity of the machines to be driven, and since in the diversity of farming practised a very wide range of machinery exists, it is necessary, in order to help the farming community at large, to have some basis on which to determine to one's own satisfaction what horsepower is best to buy. It is by no means economy to have a rated horse power very much higher than is actually needed to perform the work in hand. Of course there is no engine built that will last as long if it is run to the limit of its capacity all the time. There should be a reasonable allowance. A gasoline engine reaches its maxim horse power when the governor is not acting. To determine the horse power required, a fair basis would be that the horse power of the motor should be equal to that required by the largest machine driven, plus 25 to 50 per cent. of the power necessary to drive the other machines—25 per cent. when the machines need not be driven at the same time, and 50 per cent. when several machines are to be driven simultaneously with the largest one. This rule can be successfully applied to average farm conditions.

To drive the various small farm machines, such as a cream separator, with a capacity of from 500 to 700 pounds of milk per hour, requires 1/5 horse power. A pump lifting about 20 gallons of water per minute from a well 50 feet deep would need about ½ h.p., based on a pump efficiency of 50 per cent. Churns, washing machines, fanning mills, grindstones, each requires about 1/10 horse power to drive them under load. A bone cutter requires about ¼ horse power, if not crowded. A hand drill, depending upon size of the holes drilled and the speed, would need from 1/10 to 1/3 horse power. These machines include practically all of the smaller machines in use on one or the other of the various kinds of farms. The total power required for all of them amounts to 1½ horse power.

The feed grinder will require from 1 to 1½ horse power, depending, of course, upon the capacity, speed of the mill, condition and kind of grain, and the fineness desired.

A saw rig could be operated by a 2 horse power, although with a 3 horse power a great deal more work can be accomplished in a given time. Assuming, then, that a farmer wishes to purchase an engine to run all these machines, we find that the horse power of the motor, according to our formula, should be as follows:

The largest machine, the saw, requires 2 horse power, the grinder and the others 1½ horse power, and small machines 1½ horse power—total, 3 horse power, 25 per cent. of which is ¾ horse power. Then 2 h.p., plus ¾ h.p., equals 2¾ h.p., the amount at which the engine should be rated. This 3 horse power engine would develop sufficient energy to drive the saw at limited capacity and many smaller machines simultaneously. Many farmers find that a 4 horse power engine is an excellent size, for besides operating all the small machines enumerated, it will, in addition, drive a feed mill with a capacity of about 20 bushels per hour. Usually this takes about 3 horse power to accomplish the work.

The large engine, however, has its place where heavy class of work like threshing, filling silos, etc., has to be done. But the question arises, has the average farmer enough of this work to justify him in investing in a large engine, or would it be cheaper to hire some one making a specialty of that class of work to do it? Should the work warrant a large engine, have it large enough to handle the work successfully; indeed it should be so large that it would be good economy to have two—a small one, which could be moved from place to place for the light work, and a larger one.

Practically all the standard makes of the four cycle engines are designed to take into the cylinder at each suction stroke, the largest possible quantity of the explosive mixture that can be taken in by suction. Then this charge of fuel, as it is often called, is subjected to a compression somewhere between 40 and 90 pounds per square inch by the returning piston. On exploding, this compressed charge gives forth a working force of nearly four times as great as the pressure of the gas at the point of exploding. Hence two engines of like bore and stroke, running at the same speed, would each consume very much the same quantity of explosive fuel, if working under full load. But an engine having only, say, 40 pounds compression pressure, develops only half as much power as one under 80 pounds, so that the former would be wasting half its fuel, or, in other words, would require twice as much fuel per horse power as the latter engine.

It is surprising what a difference there is in engines in this respect, and the economy in fuel should be looked into carefully. Tests demonstrate that low compression engines are "gasoline wasters." High compression engines, about 85 pounds to the square inch, give the best results. The smaller the

horse power of the engine, the more it will use relatively, and the best engine on the market will not get much, if any, under a gallon a horse power for 10 hours run under full load, despite the claims of manufacturers.

If there is a difference in engines in this respect, there is, of course, a cause for it, and if so, what is it? To an economical engine a good compression, a good mixing and a good sparker, proportionately timed, are absolutely essential. The first we have discussed. We shall now briefly deal with the remaining two. The nearer the mixture of air and gasoline approaches to a perfect gas, the higher the efficiency of the engine. It is generally considered that a proper mixture consists of one part gasoline to seven parts of air. Choose an engine with the mixer located near the head and requiring no regulation of the air. An engine drawing its charge through a long pipe is a hard starter, especially in cold weather. A small glass reservoir on the mixer saves much annoyance, as one is able to see if the pump is acting, the tank empty, or water in the gasoline. Next come the methods of ignition, the hot tube and the electric spark. The former is all but obsolete; the latter is divided into two kinds, jump and touch spark. Generally speaking, jump spark has been adopted for high speed engines, the touch for slower speed power purpose engines. The jump spark has the advantage of no mechanical moving parts, and is subjected to a little wider variation of the ignition point and is usually run with dry cell batteries. The touch spark is mechanically operated. The spark is produced by snapping a pair of contact points. As these points are separated after completing the electric circuit, there is produced a bright spark.

The power of the ignition greatly influences the consumption of fuel, which may be reduced from 25 to 30 per cent. in a given horse power by using the proper quality of apparatus. There should be some simple method of timing the spark. This is very essential, as the explosion should take place just before the piston reaches the farthest point back. The greater the speed of an engine, the more advance on the spark. This should be regulated so as to throw it past the centre for starting.

Avoid high speed engines for power purposes; the race horse is all right on the track but cuts a poor figure at the plow.

A Traction Engine for the Farm.

In my last report I offered some remarks on the need of a useful, light tractor for farm purposes. Since that time the first agricultural motor contest ever held in North America was carried out at the Winnipeg Industrial Exhibition during the week of July 11-17, amidst a concourse of interested farmers. An abridged account of the trials, taken from the report of Mr. E. W. Hamilton, of Winnipeg, is appended:—

This contest was widely advertised in local and foreign parts. The following manufacturers responded willingly, sparing neither time nor expense to give the public a complete demonstration of what the gas tractor will do when applied to farm power work:—

Marshall & Sons Co., Ltd., Gainsborough, England, a 30 horse power, two cylinder tractor.

Transit Thresher Co., Minneapolis, Minn., a 35 horse power, four cylinder tractor.

The International Harvester Co., 15 horse power; 20 horse power one cylinder tractors, and a 40 horse power three cylinder tractor.

The Universal Motor Co., Regina, a 20 horse power four cylinder motor.

According to the rules and conditions laid down by the Exhibition Association, all engines had to be officially weighed.

The contest was arranged to:—

First.—Pull a load of sand and gravel in proportion to the rated horse power of the engine over a 2,999 feet course, measured by the City Engineer Department, for a period of two hours, the engine lapping the course as many times as possible

Second.—Plow with as many plows as each tractor could draw in tough gumbo for a period of two hours.

Third.—The construction of the different machines as applicable to the needs of the farmer.

The first start in the haulage test was made by the International Harvester Co.'s 20 horse power engine over a course that was anything but macadam, made up of rough prairie sod for the greater part, interspersed with patches of loose gravel. This gravel was *what determined the size of the load and the tractability* of the engines. The 20 horse power International, which started with two wagons and a load of 18,940 pounds, was obliged to drop one wagon when an unusually large piece of gravel was reached. The Transit Thresher Co.'s motor, which began with three loads aggregating 30,030 pounds, cut off one wagon for the same reason, reducing the load 18,040 pounds. The others took warning, and started with loads which they were sure of hauling. The International 20 horse power made eleven laps and the Transit Thresher engine five. The steering chains of this engine broke, delaying it considerably and thus accounting for the small number of laps made. Nevertheless it made excellent time during the last laps. The third motor starting was the International Co.'s 15 horse power, hauling a load of 9,150 pounds. It made a run of ten rounds in 116 minutes, using 31.5 pints of gasoline.

The next to take the track was the Kinnard-Haines 30 horse power, four cylinder tractor, finishing with a load of 18,040 pounds, making nine laps in 120 minutes, and using only 48 pints of gasoline for the entire two hours.

Marshall & Sons Co.'s 30 horse power, two cylinder tractor lapped the course eleven times in 121 minutes. It was a beautiful run and the little English machine attracted much attention.

The International Co.'s 40 horse power, three cylinder, hauling a load of 9,150 pounds, made a record time of eleven rounds in 116 minutes.

The Universal 20 horse power, four cylinder tractor came next with a load of 9,540 pounds, but an unfortunate break-down did not permit it to finish the first lap, and accordingly was withdrawn from the contest.

In every case the judges, who were Prof. A. R. Craig, of the Manitoba Agricultural College, and Mr. William Cross, of the Mechanical Department of the C. P. R., carefully measured both water and gasoline at the start of the haulage run and measured the unused portion at the finish, in order that each machine might be judged as to fuel and water economy.

The ploughing field consisted of good old Manitoba gumbo, which was just about as hard a class of soil for any plow to negotiate as can be found anywhere on Mother Earth, Heavy rain has somewhat softened it, however, reducing the draft per fourteen inch furrow from 900 to 650 pounds, a dynamometer test having been made on the same ground the Saturday previous.

The lands had been previously laid out and measured by the Cockshutt Plow Company, who furnished all of the plows for the occasion and experts to handle them as well. They were all of the fourteen-inch size and of the solid gang type, and it must be said did beautiful work in every case.

The International Harvester Co.'s 20 horse power made the first start in the plowing test, drawing three plows, and in its allotted time of two hours, turned 2.042 acres.

The 15 horse power of the same company, with three bottom gang attached plowed 1.795 acres, consuming 2.3 gallons of gasoline per acre.

Next in order was the Transit four cylinder motor, with its eight foot drive wheels and a patent steering device, pulling six plows. Some very nice work was done with this engine on the 2.957 acres which it plowed.

The Marshall two cylinder motor drawing three bottoms and burning kerosene made a very creditable test.

The 40 horse power, three cylinder International Harvester Company tractor was next hitched on to five bottoms, and in two hours plowed 2.847 acres. This engine turned an acre in forty-two minutes on 2.86 gallons of gasoline.

The last engine to tackle the plowing was the Kinnard-Haines four cylinder motor with a load of six furrows, and with the exception of one minor stop, the run was errorless. It completed 3.24 acres in one minute over the two hours, 2.5 gallons of gasoline per acre being the fuel consumption.

As the construction of any farm tool is of vital importance to the farmer, the judges spent considerable time inspecting the working parts and watching the ease with which they could be manipulated. They then carefully arranged their data on the basis of 155 points, calculated as follows:—

	Points.
Gasoline consumed	20
Haulage per horse power	15
Distance run without replenishing gasoline	5
Distance run without replenishing water	5
Turning facilities	10
Protection from mud and dust	5
Accessibility	10
Speeds	10
Manipulation	10
Clearance of parts from ground	10
Steadiness of running	10
Acres ploughed per unit of gasoline	10
Acres ploughed per minute	15
Price f.o.b. Winnipeg, per lbs. weight	10
Total	155

When the final results were announced, it was found that the Kinnard-Haines tractor had carried off the first prize gold medal honours, with 117.6 points. The International Harvester Co.'s 15 horse power motor came second, with 117 points, and was declared the silved medal winner. Marshall & Sons, Gainesborough, England, took third honours and the bronze medal, with 108.3 points. The other tractors in order were credited as follows:—

International Harvester Co., 40 horse power, 107.7; Transit Thresher Co., 35 horse power, 103.3; International Harvester Co., 20 horse power, 101.5.

It is a large problem, this one of farm power, for the farmer to solve, and contests of this nature help materially to find a solution.

THREE MONTHS' COURSE FOR TEACHERS.

At the request of the Education Department, received through you, I have drafted a course of elementary industrial training to be given to public school teachers during the Spring Term.

This course of study is intended to be suggestive, rather than a prescribed one suitable for all grades of schools and conditions. The student is not given a set of exercises to be carried out rigidly, according to the needs of special "forms" in the schools; but more particularly trained to exercise thought and judgment, and to develop individuality and originality. It cannot too often be repeated, that the purpose of the work is not primarily industrial, but educational, for, when properly carried out, this course will not only train muscle and develop skill in manipulation of various tools and materials, but through muscular or motor training, be productive of superior intellectual and moral fibre. Great stress is laid on Drawing, Constructive Design and Construction. "Every workman should, for the most part, be able to conceive clearly and accurately in his own mind the shape of everything he mav have to make, or work with. This makes it the first condition of skill that he should master shape in his own mind, and that mastery requires him to be a geometer."

The student is made acquainted, as far as possible, with the conditions that governs the industrial phases of education, and their application to Public School conditions; and so he gains experience that will prove of inestimable service to him, when thrown upon his own resources. The examples and exercises used must all be taken as illustrating principles, and not "a cut and dried" scheme designed to meet the requirements of every locality. Indeed, it may be said, that the measure of usefulness and success attained at this course, especially from an educational point of view, will be in a direct ratio to the degree in which the student puts *himself* into the work, for the scheme furnishes sufficient material from which, by selection and evolution, it will be possible to arrange a practical course suitable for any school or district

Students should bring with them any good manuals they may have on the subjects of the course. All should procure a sheet of carbon paper, tracing paper, and a supply of drawing paper (unglazed), a set of Reeve's water colour No. 50A, a box of crayons, a few sticks of charcoal, Japanese brush No. 15, a water cup, a set of good drawing instruments, and from three to five H. pencils. Tnese may, however, be bought from the supply houses in Guelph.

Visits will be made to local schools to study equipment, organization, etc., and to local industries for observation of processes.

Time Table.

——	Subject.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
8.45 to 9.45	Drawing.	P. & S. Geometry.	Working Drawing.	Design.....	P. & S. Geometry.	Working Drawing.	Design Construction.
9.45 to 12.00	Practical work.	Wood working	Metal working.	Wood working.	Metal working.	Wood working.	Metal working.
1.30 to 4.00	Constructive work.	Paperfolding Cardboard Basketry.	Colour work.		Clay modelling. Weaving.	1.30–2.30 Blackboard drawing. 2.30–4.00 Planning schemes.	

(a) Constructive Work: The general principles underlying the whole of this work are, the gaining of knowledge through the general and combined activity of the mind and the senses, that is, through doing, in its widest and most general sense; the making of new forms and combinations, the giving of definite expression to ideas and mental images; the rendering of the inner outer, is the great Froebelian doctrine of creativeness.

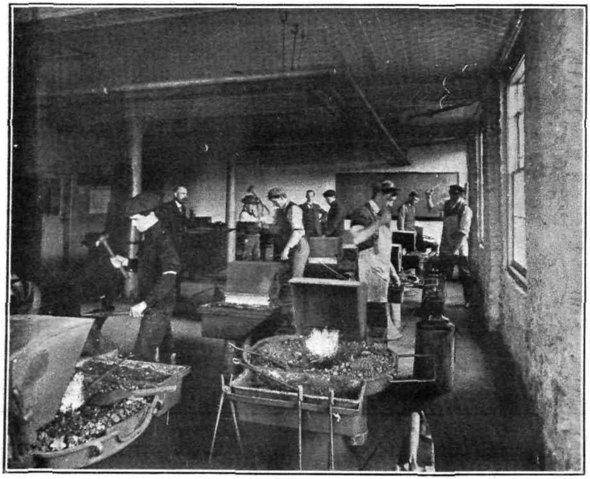
Paper folding, cutting and mounting.
Simple designing—paper applique.
Cardboard work—thin and thick boards.
Modelling—clay and sand, and papier maché.
Weaving—Raffia, rattan, rush, and yarns.
Basketry—Woven, coiled, and sewed.
Simple book-binding.
Planning schemes suitable to the children's interests and abilities.

Books of Reference:

Primary Handwork—Seegmiller.
Correlated Handwork—Trybom and Heller.
Cardboard Construction—Trybom.
Paper and Cardboard Construction—A. H. Chamberlain.
Story Telling with the Scissors—M. H. Beckwith.
Occupations for little fingers—Sage and Cooley.
Clay Modelling—Holland.
Clay Modelling—Unwin.
Handloom Weaving—M. P. Todd.
Practical and Artistic Basketry—L. R. Tinsley.

(*b*) *Wood Working*: Presents a comprehensive view of Manual Training. The bench work aims to inculcate principles emphasizing general lines and proportions, construction, decoration, and the reason for doing work in the particular way, which is the result of practical constructive experience. The work is embodied, as far as posisble, in complete finished articles. In this way the student acquires correct ideas of methods of construction, proportion, setting out, and general technique of the work.

Knowledge of the proportions of joints used in carpentry, joinery, and cabinet-making, and their correct application. Position of mortises with regard to the neutral axis. Calculation of quantity of lumber necessary for making the object. Estimation of cost of articles made. Fastenings—*dowels, pins, cleats, keys, wedges, glue, screws and nails. Tools—their construction*, care, use and sharpening. Analysis of the action of cutting tools; cutting angles, etc.



Agricultural Students at Work in the Blacksmith Shop.

Books of Reference:

Educational Woodworking—J. C. Park.
Problems in Woodworking—Murray.
Problems in Furniture Making—Crawshaw.
Beginning Woodwork—Van Deusen.
Elementary Sloyd and Whittling—Larsson.

Farm Carpentry: Has in view the need of students taking up Elementary Agriculture for simple carpentry, such as, making of tool handles, trays, stakes, crates; principles of framing; fastening; hinging; locks, etc.

Books of Reference:

Woodworking for Beginners—Wheeler.
Every Man's Own Mechanic—Spon.
Carpenters' and Joiners' Handbook.
Benchwork—Goss.

Metalworking: An effort is made to teach the fundamental principles of the work and to give such exercises as will best train the eye, quicken thought and develop self-reliance. Perhaps no form of manual training involves greater dexterity of hand, accuracy of eye, and quickness of thought than smith-work. The necessity of striking "while the iron is hot" is impressed at once upon the mind of the pupil; from the first simple exercise in "drawing out" he realizes that a moment's delay may result in a total failure, and that the necessity for keeping the mind on the alert, to meet the changing conditions of the thing in hand, becomes imperative; and instant judgment is brought continually into play.

Machine shop work includes chipping, filing, fitting, and finishing of work in cast iron, wrought iron and steel. Theory and practice in the grinding of cutting edge tools used in general machine shop practice; operation and use of lathes and drills. Screw cutting by hand and machine.

Art Metal Work consists of shaping, raising, and decorating simple forms in brass and copper.

Soldering, brazing, annealing, hardening, and tempering.

Forging exercises in drawing out, shaping, bending, upsetting, welding; construction of rings, chains, chisels, etc.

Books of Reference:

Principles of Fitting—Whittaker.
Metalworking—Pearson.
Forty Lessons in Engineering Workshop Practice—Mitchell and Davy.
Workshop Appliances—Shelley.
Forge Practice—Bacon.
Copper Work—Rose.

(c) *Drawing*: The aim of this course is to lead the child to appreciate the power in expression, to observe closely, and to discriminate values, which are involved in correct observation; to train hand and eye to co-operate with judgment; to test values in symbols, and to interpret by judgment the co-operation of hand and will in obedience.

Pencil crayon, charcoal, brush, water color and ink.

The structure and function of the brush in defining forms by their masses.

Colour schemes worked out from the colour view point, illustrating various harmonies.

The use of squares, triangles, and instruments.

Plane geometry, practical problems, lines, angles, and polygons.

Construction and use of plain scales.

Orthographic projections of solids—three or more views.

Cutting and oblique planes and sections.

Isometric projection.

Constructive Design.

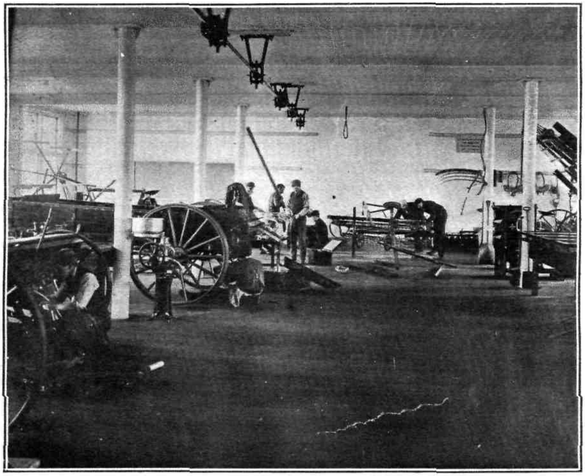
Working Drawing.

Machine Drawing.

Tracing—Blue printing.

Books of Reference:

Bases of Design—Walter Crane.
Line and Form—Walter Crane.
Principles of Design—Batchelder.
Classroom Practice in Design—Haney.
Mechanical Drawing—Anthony.
Machine Drawing—Low.



In the Implement Room. Farmers' Boys Studying Farm Machines.

Finishing: The primary object is to give the student a knowledge of the various styles and methods of wood finishing without which, even the best constructed articles lose much of their beauty, refinement, and attraction. The main purpose is to impart an agreeable surface, colour, and texture to the wood and to preserve it.

Staining, fuming, filling, shellacing.
Oil and wax polishing.
Pigments, priming, coats.
Oils, driers, brushes.
Painting and glazing.

Books of Reference:

Polishes and Stains for Woods—Upcott Gill.
Natural Woods and How to Finish Them—Berry Bros.

Forestry, Lumber, Wood: In this connection an attempt is made to correlate with Nature Study Work. The pupils are taught how to recognize the common woods, the characteristics of good lumber, and the defects in wood; the influence of these, in planning and designing.

Forest preservation—propagation, time of cutting, pruning.

Trees—Classes, structure, growth, seasoning, shrinking, and warping.

Properties—Durability, elasticity, stiffness, density.

Varieties of common woods—pecularities of each, colour, grain, identification.

Defects in lumber—Resin pockets, knots, shakes.

Decay and its causes—Preservation.

Lumbering, transportation, sawmills, grading widths.

Books of Reference:

Primer of Forestry—Pinchot.

Timber—Hasluck.

A First Book of Forestry—Rothe.

Theory and Practice: Manual Training as a factor in general education. History of Manual Training; the various systems, Russian, Sloyd; progress of Manual Training in Canada.

Books of Reference:

The Place of Industries in Elementary Education—Dopp.

School and Society—Dewey.

Education and the Larger Life—Henderson.

Theory of Educational Sloyd—Salomon.

Method of Teaching—Organizations, courses, equipment, plans, estimate of cost.

Books of Reference:

Economics of Manual Training—Rouillion.

Manual Training Made Serviceable to the School—Goetze.

Reports of Inspector of Technical Education.

In view of the facilities and inducements to be offered by the Education Department, it is fully expected that a large number of students will avail themselves of the benefits of the course. Students leaving us should have a wider view, and a greater appreciation of the immense influence they are calculated to exert on the industrial and agricultural outlook of their future pupils.

THANKS.

I cannot close this brief report without sincerely thanking, on behalf of the whole student body, those manufacturers who have generously donated specimens of their different machines and implements to the Department, and so facilitated and made more practicable our course of instruction

in Farm Mechanics. No student need now leave us without a knowledge of the general construction and effective use of a large number of implements usually employed in farm operation. The donators are: —

Massey Harris Co.

1 No. 5, 6 feet Binder, 3 horse.
1 No. 4, Carrier for No. 5.
1 No. 3, Hay Tedder, 2 horse, 6 feet fork, 2 prong.
1 No. 3, Cream Separator, 300 lbs.
No. 1 Side Delivery Rake, trees and yoke.
1 Hay Loader and Fore Carriage.
1 13 tooth Cultivator, No. 7 Standard Lever.
1 No. 3 Manure Spreader, 50 bush.
1 No. 4 Drill.
1 Broadcast attachment.
1 No. 8 Standard Disc Harrow, 16 inch.
1 No. 12, 20 Section Mower.
1 Binder attachment and stand.

Aspinwall Potato Machinery Co., Jackson, Michigan.

1 Potato Cutter.
1 Potato Planter.
1 Four Row Double Cylinder Sprayer.
1 Potato Sorter.

Gilson Manufacturing Co., Guelph.

1 2½ horse power Gasoline Engine.

The Champion Potato Machinery Co., Hammond, Ind.

1 Potato Digger.

Tolton Bros., Guelph.

3 Fork Sling Cars, mounted on tracks of steel, wood and rod.
1 Fork Car for wood track with horse for attachment.
1 double machine for Slicing and Pulping Roots.
1 Single Pulper.
1 Seed Harrow.
1 No. 8, 5 feet cut, Pea Harvester and Buncher.

J. Fleury & Sons, Aurora.

1 10-inch Grain Grinder.

Frost & Wood, Smith's Falls.

1 Horse Rake.
1 Gang Plow, straight and rolling coulters.
1 pair Sod Bottom.

Louden Machinery Co., Guelph.

Litter Carrier and track.
2 Forks with carrier and track.
2 Slings with carrier and track.
4 Stanchions.
4 Door Hangers.

The Templin Manufacturing Co., Fergus.

1 Fanning Mill.

Wilkinson Plough Co., Toronto.

1 No. 4 70-bushel Manure Spreader.
1 Climax "A" Mounted Ensilage, Straw Cutter.
1 Reversible Disc Plough.
1 No. 3 Plough, gauge and furrow wheels.
1 No. 4 Plough.
1 No. 5 Plough.
1 No. 7 Plough rigged with skim and wheel and with coulter and landside extra.
1 double mouldboard Drill Plough with potato digger attachment.
1 No. 1 Drag Scraper.
1 No. 3 Wheel Scraper.
1 Steel Tray Barrow.

Through the kindness of the Massey-Harris Co., I was enabled to spend about ten days at their factory in Toronto, visiting different departments, and taking part in the erection of the various implements that the firm manufactures for farm use.

The prize of twenty dollars, open to competition among the second year men only, for the best drawing of a barn, offered by the Louden Machinery Co., Guelph, was awarded equally between Messrs Snyder and Reek.

This year the second year students taking farm mechanics were taken through various factories devoted to the making of agricultural implements and machinery, to study and observe their operation and erection. We paid visits to, and had every facility offered us by, the following firms:

The Wilkinson Plough Co.. Toronto.
The Fairbanks-Morse Co., Toronto.
The Massey-Harris Co., Toronto.

To these firms for their gracious reception and attention, and also to those who have donated implements and machinery, we tender our grateful thanks.

Permit me, in conclusion, to thank you for the cordial support and generous consideration in affording me facilities to acquire further and more detailed information respecting many branches of the work carried on by this department, and thus rendering the instruction given more effective in farm life.

I have the honour to be, Sir,
Your obedient servant,

JOHN EVANS.

Teachers' Gardens, 1908.

In the Marden School Garden, 1908.

PART XX.

THE PROFESSOR OF NATURE STUDY.

To the President of the Ontario Agricultural College:

SIR,—I have the honour to submit my fourth annual report on the work of the Nature Study Department.

SUMMER CLASSES.

The work of the year 1908 was marked by a decided advance towards realizing one of the chief aims for which the Nature Study Department was organized. With the hearty concurrence and support of the Education Department the work was specially organized to meet the needs of the rural and village schools of the Province. While our work in Nature Study has always had a distinct agricultural bias, yet it was chiefly town and city teachers who took advantage of the instruction offered, and the work naturally was fitted to their requirements. This summer, however, a special course called Elementary Agriculture and Horticulture was commenced. It is specially adapted to rural school work and leads to a certificate qualifying for instruction in School Gardening.

A syllabus of study based on our experience with previous classes of teachers was prepared embracing practically every department of study in the science of Agriculture. It was practically the same outline as that printed in our report for 1907.

As the complete course is for a continuous three months' term or two summer sessions and a winter reading course, only part of the work outlined was covered this year. It was planned to bring every department of the College into co-operation in giving the teachers a broad view of the field of agricultural interests so that they might have a proper perspective in their view of agricultural education for the schools.

The draft of the time table indicates sufficiently the allotment of time for each subject and also how far the attempt to bring the work of the whole College into the general conception of agriculture was successful.

——	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
8.30-10.15........	Physics.	Entomology	Physics.	Bacteriology or Animal Husbandry	Seminary Work.	Gardening
10.15-12.00........	Botany.	Chemistry	Botany.	Field Husbandry.	Poultry or Dairy Husbandry.	
1.30-3.30	Farm Carpentry.	Horticulture.	Botany or Forestry.	Horticulture.	Gardening.	

It might appear that the course was overloaded with too many subjects and lacked in giving sufficient emphasis to the strictly so called agricultural and horticultural subjects. But there will always be a difficulty in an adjustment for this defect; some subjects will be over emphasized or under emphasized. In the general arrangement, Agriculture (Field Husbandry), Horticulture, Botany, Physics and Entomology have been provided for as *Major* subjects, and Chemistry, Bacteriology, Poultry, Dairying, Animal Husbandry and Manual Training as *Minor* subjects.

The course must be broad to make the most for the diverse needs of the country and the diverse capabilities and preferences of the teachers. As the selection of books for the reading course and the answer to our enquiries show, the teachers have found as much use for their instruction in Bacteriology, Poultry or Dairying as for that received in Botany or Agriculture for example. With very few exceptions our correspondents insist that they would not choose to have restriction on subjects. Some acknowledge that they received their greatest help in quite unexpected parts of the course which, if they had had an option, would have been untouched. They agree that more time would be an advantage, but realize that under the circumstances the arrangement for their instruction could not be much bettered. It is not possible to have the features of a long term of instruction in a short *summer session. Many undesirable things must be submitted to.*

The first class comprised the following students:

Miss Bertha Batchelor, Toronto; Miss H. L. Beardmore, Toronto; George Clayton, Gore Bay; Miss Lillian F. Furlong, Kennansville; Miss Ena Henderson, Underwood; Thos. J. Hicks, Selkirk; Miss Marian Langdon, Braemar; Miss Jane Lush, Sault Ste. Marie; Miss M. Vivien Martin, Hagersville; Miss Amy E. McKowan, Avonton; John A. MacDonald, Thamesford; D. A. McDonald, Hickson; George McMillan, B.A., Belleville; Miss Essie M. Sann, Mountain; Miss Mabel L. Stewart, St. Catharines; John R. Tuck, B.A., Brampton; Miss Louise Waterman, Bensfort; Miss Mary Yates, Toronto; John W. Yake, Drayton.

Messrs. McMillan and Tuck were High School science teachers, and Miss Yates a Women's Institute lecturer; Misses Beardmore and Batchelor were interested as gardeners. The remainder of the class were public school teachers.

Suggestion for Subsequent Years.

When this work was first arranged for it was planned to cover the course of instruction leading to the certificate in Elementary Agriculture and Horticulture in two summer terms. Our experience of the past summer suggests the advisability of a modification of the plan. It would be a difficult matter for our instructors to have to arrange two short courses for two separate classes of teachers. The demands of the Summer School already break in awkwardly on their other duties, and two classes would entail altogether too much digression from these.

I would propose, therefore, to make the course which we now call Nature Study the first or preliminary year in Agriculture. In this session the work in Horticulture, plant, seed and insect collecting, school gardening and in general the outdoor studies could be largely completed. This would make a good foundation for the second year's work and allow more time for practical instruction in laboratories and individual experimenting with plants in the gardens. Besides it would bring relief by reducing the number of subjects. Those teachers who have taken the work in Agriculture in 1908 could reverse the order and take the Nature Study in 1909.

EFFECT OF THE SUMMER'S COURSE ON THE TEACHER AND HER WORK.

Through correspondence in connection with the reading course, I have learned something of the benefits of the course to the teachers themselves and their use of the instruction in the classes in their schools. In reply to the question "Has your work as a teacher been changed in any way by your summer's work?" I have received replies from several such as the following:

"My summer's course has given me renewed interest and inspiration for this year's work. . . . . Agricultural subjects seem to crop up everywhere, especially in geography."

"Yes, I think my work has been changed; we now seem to look more for the *Agricultural* side. I find the instruction of use in all subjects."

"Although raised on a farm, I now look upon Agriculture in a different light. I see that to-day it is not only necessary that farmers should know "how," but that the "why" is a very important factor in success. I am more fully convinced than ever that a great amount of the work taught in the average public rural school is of little use, and that too often the boy is led in early life to scorn the farm and all its connections. I formerly taught Agriculture from a text book. I have ceased that, I hope, forever. . . . . I formerly taught it because I was obliged to, now because the pupils are *too enthusiastic* to let me miss a single lesson."

In reply to the question "What instruction have you been able to give to your pupils in Elementary Agriculture and Horticulture this fall?" I have received several interesting replies. The possibility and desirability of introducing the work into the schools is clearly indicated. One who teaches in a dairy district writes:

"Next week I am having a judging contest on a dairy cow, with my scholars. We use the regular score card used at Guelph, and the boys take great interest in the work. This is followed by oral and written language lessons on 'An Ideal Dairy Cow.'"

Another who teaches in a country where general farming obtains writes:

"I have given instruction this fall in preparing soil, drainage, and the planting of bulbs. A number of pupils have begun growing hyacinths and tulips of their own; have given illustrated lessons on budding; have had a series of very interesting lessons on the 'Care of Milk for Home and for Creamery Use.' The subject of bacteriology was especially helpful here. Have had a number of collections of weed seeds made; have succeeded in making most of my pupils acquainted with many common weeds in this locality."

Another writes:

"We have been following Mr. Dearness' course in the *School and Home;* lessons on corn, birds, seed dispersion, weed seed collecting and tree seeds with the third class . . . . I find, however, that indirect, informal instruction in Agriculture comes in almost everywhere and a few words to a group of children may mean more than a cut and dried lesson to all."

Another teacher replies:

"My work this fall in Agriculture has been on the following subjects: Soil bacteria, identification of common farm weeds found in this vicinity by sight and by seed. Nature Study is brought into nearly all my other subjects also."

THE WINTER READING COURSE.

At the close of the July session a consultation was held with the teachers to make a selection of books for winter reading. It was realized that the instruction of the summer was taken in that condensed and hurried

manner inseparable from short courses and that the work would be made more effective by a short course of supplementary reading. In addition to the class in Elementary Agriculture, nine of the class in Nature Study joined. There was some difficulty in choosing books that met the wishes and needs of the whole class as the field is wide and the number of texts large. We were desirous moreover to keep the selection small so that no one would feel this part of their instruction a burdensome task.

The course arranged for 1908-09 is as follows:

(1) For October and November—"Nature Study and Life"—Hodge.

(2) For December—"Story of the Plants"—Grant Allen.

(3) For January—"Chemistry of the Farm"—Warrington.

(4) For February—"The Soil"—King.

(5) For March—"Canadian Dairying"—Dean.

(6) For April—"First Lessons in Poultry Keeping."

(7) For May and June—"Botany"—"An Elementary Text Book"—Bailey.

The plan adopted for making this branch of the work effective is that of the "Correspondence School." Towards the end of November a circular letter was sent out with questions on the first text. The replies have been satisfactory and go to show the possibilities of this line of instruction in influencing the teaching in the schools of those concerns of the people met with in their every day labours or recreations.

The first letter dealing with the reading of Hodge's "*Nature Study and Life*" is given here to indicate our aims and method.

Dear Madam,—By this time, I presume, you have made an acquaintance with Hodge's *Nature Study and Life* as the first text of our Winter Reading Course.

I shall be pleased to receive from you at your convenience answers—and they may be as brief as you will—to the questions submitted below. Please do not look upon them as a dreadful "quiz" to find out what you do not know, but rather as a chance to give expression to some of your conclusions regarding Nature Study.

Please write the answers in ink on foolscap paper.

With best respects,

Yours very truly,

S. B. McCready.

1. *What plan did you follow in reading the book?*

2. Have you noticed whether it has influenced your work or your attitude to your work as a teacher?

3. *Have you made any use of any particular part of it in your classes? If you have,* please state what the topics were.

4. Where does the country boy or girl come in, in his schemes of Nature Study? Could you suggest any topics that should be treated of if the book were to be made of wider scope?

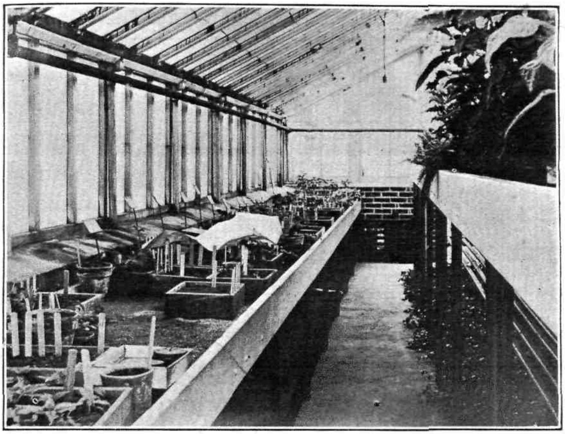
5. "The love of a flower in the heart of a child is the highest thing that nature study can hope to develop,"—p. 91. If you think this true, explain; if you think it is not true, explain what you hold to be the highest aim.

6. One hundred and thirty-six pages are devoted to insect studies; about how many different species of insects can you recognize? How many of the butterflies listed on pp. 264-274 do you know on sight?

7. Fifty-seven pages are devoted to a consideration of bird studies; about how many of our common birds do you know by sight or song, or by both?

8. In what ways may the Nature Study of the schools affect the lives of the people?

A few of the answers are submitted as showing the readiness of teachers to acknowledge new pedagogical view points and to adjust themselves to the consequent new responsibilities.



Plant Propagation and Experiments, 1908.

A Lecture on Potatoes.

In answer to question 2 regarding the influence of the book:

"I feel quite sure that this book has influenced, is influencing, and will influence me in my school work."

"I have not noticed that it has influenced my work particularly, but I have noticed that since being at Guelph last summer I have enjoyed my work better than before and the children have worked better too."

"This book has been an inspiration to me. The reasonableness, the common sense attitude, the emphasizing of the economic side of Nature Study, above all the scientific and aesthetic have appealed to me very strongly."

In answer to question 3 regarding the use in their teaching of topics suggested in the book:

"Have used in my classes various parts from time to time. Some of those used this term have been:—'Dogs and their proper care;' 'Cats: their use and abuse;' 'The common House Fly;' 'The Honey Bee;' 'The Bumble Bee;' 'Birds: their use, care and protection, (had a splendid lesson on this, as a boy brought in a young plover with a part of its wing shot away); 'Weeds and identification through specimens and seeds.'"

"The topics I have made use of are:—'Insects of the Household: Flies, Mosquitos;' 'Beneficial Insects: Bees;' 'Insects, Beneficial and Beautiful: Butterflies and Moths;' 'Insects of the Garden: Tent Caterpillars and Cutworms;' "Flowers, Plants: Bacteria and Moulds.'"

"I have made some use of what I have read but intend to put more of it in practice. We have had some interesting talks on the Domestic Animals. Then plant growth has made my Literature lessons more profitable. The section on trees helped also, as we had a list of trees to study and draw for our County Examinations."

CONCLUSIONS: There seems to be a very important place for a Teachers' Reading Course in any schemes for the introduction of Agriculture into the public schools. Our teachers in most cases have not had their reading directed towards the subject while receiving instruction at the High or Normal Schools. It comes to them now as a new subject in their work of teaching. A reading course can help to direct the efforts of the teachers after they have been awakened into interest by preliminary instruction of a practical nature here at the College. It may help to sustain an interest which, aroused in the pleasant environment of a summer school, is in danger of lagging in the winter isolation of a country school. It tends to that effectiveness which comes from working together in a common interest. There is need, however, of keeping the list of books small and of having a supervision of a suggestive and helpful character.

THE CLASS IN NATURE STUDY.

The class in Nature Study was made up of twenty-nine teachers, six of them being from the United States. Nine of the number were teachers in country schools, and the remainder teachers in graded schools of towns or cities. The work followed was similar to that taken in previous years. Much of the instruction was taken out of doors, about the College, in informal talks or lectures. There were field excursions for collecting weeds and insects, and laboratory exercises for a subsequent study of them. The College Museum was much used for becoming acquainted with the forms of our common birds and this was supplemented by bird studies on picnics and tramps in the woods.

This class joined the students in Agriculture in some branches of their work. They took instruction together in Horticulture, School Gardening and some of the Botany. Indeed our Nature Study altogether is always never remote from an economic agricultural consideration. The plants studied are garden flowers, vegetables in the school gardens, crops in the fields, weeds in the lawn and garden and the shade trees of the campus.

A Lesson Out-of-doors—Plant Propagation.

Schoolmaster's Home. Marden School.

The animals studied include the fowl at the Poultry department and the cows in the Dairy department as much as wild birds and other animals. On the mechanical side of the study there is consideration of the farm machinery as much as that used in the city factory for making pianos or sewing machines or cream separators.

In another part of this report there will be found a few extracts from letters received from some of the teachers who joined the reading course. There is reason to believe that the work taken here enhances the value of the instruction given by them in the schools besides bringing to them great pleasure in their work.

We were favored with three special lectures by outsiders. Mr. Dearness, Vice-Principal of the London Normal School addressed the class on "The Field and Method of Nature Study," Mr. W. E. Saunders of London on "The Lives and Habits of Birds," and Mr. W. D. Hobson of Woodstock on "Our Common Birds and their Songs."

While the subject of Nature Study naturally deals most directly with the common things of the fields and woods, there is a large field for observation and study in the workshop and factory and in the products of man's handiwork. For town and city children this may offer the readiest and best nature study material. In following out this idea the class visited the Guelph Gas Works, the Guelph Paper Box Factory, Tolton's Agricultural Implement Works, Goldie's Flour Mills and the Bell Piano and Organ factory. At all the places we were given a hearty welcome and taken in hand by guides who showed us about and explained the processes of manufactures. Our classes owe much for the pleasure and profit of such visits to our Guelph industries. During the past four years we have visited most of the city's manufacturing plants. In every case we have been treated very kindly indeed.

Outside firms have been no less kind. In the spring the Third Year Class made a visit to Hamilton and the Niagara country and were welcomed and instructed by the International Harvester Company, the Petrie Cream Separator Company and the Hamilton Iron and Steel Company, of Hamilton, by Mr. E. D. Smith at his nurseries at Winona; by Mr. Peart at our Jordan Experimental Fruit Farm, and by the Ontario Power Company at Niagara Falls. To all of these our thanks are extended.

School Gardens.

The classes had a very successful experience with their gardens this summer. There were four reasons for this. In the first place our ground was much improved over previous years by repeated cultivation and was in good condition for working into garden plots on the arrival of the class. In the second place there was no delay in commencing operations; on the first day of the session the teachers were introduced to the work and allotted their plots. And in the third place the work was taken as a recreation and instruction given altogether informally; the gardens became a favourite resort for the sudents in the evenings where they compared notes and put their plots into order. Besides we had the good services of Mr. Howes, Principal of the Consolidated School, in helping, advising, suggesting and explaining. He was available to students at whatever time they might come to him. The gardens belonging to the children of the Consolidated School were used for illustration purposes.

The students learned much too from a visit to the garden at Marden ... hospitality and Mr. Buchanan's explanation

of how he conducts his work, we extend our thanks. The Marden school garden is in size, arrangements and undertakings such an one as might be undertaken in many of our country schools.

All the teachers in Agriculture and Nature Study had gardens. A few teachers from the other classes also undertook the care of plots.

The following comprised the class:

Nature Study.

Barber, Etta L., Miss, Guelph.
Barbaree, Mary M., Miss, Nassagaweya.
Brown, Isabel H., Miss, Toronto.
Calvert, Lula, Miss, Nassagaweya.
Cameron, Carrie, Mrs., St. Catharines.
Doane, Emma, Miss, Cleveland, Ohio.
Duff, Mary, Miss, Lakefield.
Gochenour, Catharine, Miss, Wabash, Ind.
Hoppins, Elizabeth, Miss, Kingston.
Kinerk, Annie, Miss, Wabash, Indiana.
McArthur, J. Evelyn, Miss, Gobles.
McHenry, Carrie, Miss, Wabash, Indiana.
McKee, Mildred R., Miss, Brandon, Man.
McKinlay, Margaret, Miss, Sarnia.
McMaster, Jessie, Miss, Sarnia.
Orr, Jessie I., Miss, Toronto.
Pickett, Laura, Miss, Vittoria.
Poppelwell, Maude, Miss, Wayside.
Robertson, Margaret, Miss, Wabash, Ind.
Ross, Alberta, Miss, Sarnia.
Ross, Carlotta E., Miss, Toronto.
Stanley, Miss, Fort Frances.
Small, Cora, Miss, Wabash, Ind.
Stanbury, Florella, Miss, Bayfield.
Stevenson, Alice J., Miss, Hewitt.
Thompson, Margaret, Miss, Port Perry.
Waite, Harriet B., Miss, Wabash, Ind.
Watson, Vesta A., Miss, Goderich.
Woods, Lizzie, Miss, Smith's Falls.

TEACHERS' AND SCHOLARS' EXCURSIONS.

We have had the following excursions during the year:
May 29—Waterloo and Berlin Teachers' Association.
June 4 and 5—Victoria Teachers' Association.
June 8—Galt High School.
June 13—Lincoln Teachers' Association.
June 16—S. Brant Public School.
June 22—Durham Teachers' Association.

The teachers' conventions were well attended and were marked by a lively interest in the meaning of agricultural education as it is represented by the College work and equipment. The Victoria County Association's visit was a particularly successful one. It had been well organized by Inspectors Knight and Stevens and Mr. Reed, Agricultural Representative at Lindsay, and their whole programme was carried through splendidly. Their excursion was for two days and the second day seemed to have almost as many representatives and as much enthusiasm as the first day. There were very few teachers of the county who were not present. As a rule the month of June is not a good time for the teachers' excursions. The crowds attending the Farmers' Institute excursions prevent the teachers remaining together as a body and taking advantage of the special instruction prepared for them. Besides the weather is hot and after a long railway journey strength fails for a busy sight-seeing tramp. When a low railway rate can be secured by the teachers' associations without joining an Institute excursion, it would be better for them to make their visit in May or September and always for two days.

The excursion arranged for the Galt High School by Mr. F. C. Hart, B.S.A., Agricultural representative in Waterloo county, brought an unexpectedly large number of school children. The Galt school was joined by others in adjacent towns and our grounds and buildings were filled all day by busy, enquiring crowds, bent on making the most of their outing. A large number of instructors would be needed to conduct the different school

THE CHILDREN'S EXCURSION ON JUNE 16TH.

In many respects the excursion of children from three of the rural schools of South Brant was most interesting. It was our first organized excursion of public school children and it showed the possibilities of an important field of service. We submit a somewhat full account of the experience in the hope of awakening a wider interest in the scheme.

For the past few years we have made a standing offer to teachers and inspectors to take charge of any organized party of school children which might come with their teachers on the Farmers' Institutes excursions in June. The pressing demands of midsummer examinations and a lack of organization amongst the rural teachers has hitherto prevented the getting of a party together.

Through the efforts of Mr. F. M. Lewis, Secretary of the South Brant Farmer's Institute, about fifteen scholars of the third and fourth classes in three of the schools in the Burford district were organized into a party under their teachers, Misses Johnson, Amy Robertson, and Iva Robertson. They spent the afternoon sightseeing under my direction. To me it was an interesting experience and to the children and their teachers profitable as well.

I have received from the teachers a few of the children's compositions treating of the day's outing. Some of their observations are suggestive of the possible educational value of this feature of the Institute excursions. A few extracts are given here:

"(1) We saw a specimen of saltpetre from Chili, and souvenir of hardened lava with 'Vesuvius' printed on it. It had been stamped while the lava was flowing. There were different kinds of coal. We also saw a devil fish with long feelers on it."

"(2) The first thing I noticed was that the stable was whitewashed, and there was not a cobweb nor a straw to be seen on the floor or ceiling, and they had iron stanchions instead of the old-fashioned way of using chains . . . and the handiest thing of all was the litter carrier. When I got home I told my father all about the stable, and as we were putting up a new barn this summer, he planned to have the stanchions and a low manger made of cement."

"And another thing Mr. McCready explained to us was how they found out how much milk each cow gave and how much butter she gave in a year. It is rather hard to explain, but nevertheless I will try. When a man milks one cow he weighs the milk and puts the number of pounds down to her, and then he puts a little milk into a bottle to see how much butter fat it contains, and if a cow does not pay for herself she is sold as quick as possible."

"(3) The different kinds of rock and ore were interesting to us because we read about them in our Geography, and can understand it better after having seen and heard them explained. . . . We went to the Macdonald Institute, and were much pleased to see the different things in the ladies' part, and I hope that some day I will be able to take a course. . . . The Consolidated School was interesting to us indeed. The gardens were nicely kept, and I hope that next time we will be able to spend more time about the school and have the pleasure of going through it."

As showing the value of the day, as measured by the parents, trustees and teachers, I submit here correspondence which Mr. Lewis had with the teachers directly concerned.

PROF. MCCREADY,
Guelph, Ont.

BURFORD, August 31, 1908.

DEAR SIR,—On June 16th you were kind enough to entertain and instruct th senior pupils from three of our public schools.

After the spree was over some time, I wrote each teacher asking for her impressio of the day's outing, and the effect upon the scholars. Each replied and very decidedl approved of the day and said the effect on the scholars was only good and helpful.

I believe we can bring a lot of them next season. Mr. Putnam is acquainted with what has been done, and has asked that I speak of it at Institute convention at Toronto on September 8.

Will you be kind enough to give me your conclusions regarding the matter, and say how many you could handle another season? It can be made a great help to our excursion in addition to the good that is done the boys and girls.

Very truly yours,

Frank M. Lewis,
Secretary S. Brant.

Copies of letters from teachers who had children at O.A.C.

Mr. F. M. Lewis,
Secy. S. Brant F. Inst.,
Burford, Ont.

Burford, June 24, 1908.

Dear Sir,—You have asked my opinion regarding the educational value of a school children's excursion to the Experimental Farm at Guelph. In reply I would state that I think it is of value in these respects:—Not only is it of value to the pupils educationally in that they see and learn many things up there which they otherwise would not, but it is of value in fostering patriotism in the pupils, and it is in the school that we rear the future loyal and patriotic citizens of a country. Just a word to show how the excursion might have the effect of fostering a spirit of patriotism. They have a broader conception of the greatness and importance of not only Ontario, but Canada as a whole, from the exhibits in the Museum and elsewhere.

It has too, I think, the effect of attaching greater importance to agriculture in the minds of children growing up in the country where possibly there is a tendency for them to weary of the life on the farm, longing to throng to the already crowded manufacturing centres.

Then in regard to the way the schools are looked after at the Experimental Farm; they furnish one of the men of the faculty to act as a guide; this man spares no pains to explain everything in a lively and interesting way attractive to the children, drawing many moral lessons from things here and there. For instance, we were in the agricultural museum and he explained the experiments which had been tried for sowing grain, and also showing which grains should be sowed first in spring and which next, and so on. The boys were greatly interested in this.

I do not think it made a very serious break in the Entrance work. I rather think it did the pupils good, although I must not say, as the Entrance reports are not yet out.

Which benefited most, the boys or the girls? I cannot say, as there were things of interest to each and all.

I sincerely hope these few remarks may be sufficient to reply to your letter, and I hope your excursion may be an annual affair.

Yours sincerely,

(Signed) Essie Johnson,
Teacher, U.S.S. No. 11.

Burford, Ont.

Fairfield Plain, June 25, 1908.

Dear Mr. Lewis,—I am sorry that my reply will, of necessity, be very insufficient and brief. I received your letter only last night, and then thought it too late to make an attempt, but now think you may possibly get it if you go to the post office before the meeting.

You ask if it made a serious break in the school studies. On the contrary it formed a most interesting introduction to many lessons. For instance the children were so interested in seeing the lava from Vesuvius, and thereby got a much more vivid conception of what lava is, and were very ready to find out more about volcanoes, where Vesuvius is, etc. The sight of the devil fish, though it inspired them with horror, also made them read with renewed interest and more real understanding, the lesson in the Fourth [illegible] for their Nature Study it afforded very solid

ground for that study, for looking at the various specimens of animals, birds and snakes, they wanted to find specimens of the same,—*i.e.*, it gave a basis of identification. Even, for the above reasons, I should say unhesitatingly that an annual excursion would be a good thing.

"Which benefited most, boys or girls?" I, myself, had no boys with me, but watching those of the other school, it seemed to me that the *practical* interests of the *boys were more awakened than that of the girls.* The visit to the poultry yard and cow barns, and the comparison of the wheat, barley and oats seeded at various times throughout the year especially impressed them with lessons of cleanliness and the value of thrift and energy.

As for the effects on the Entrance pupils, it seems to me that it would be better for them to go on the excursion before they get to the Senior Fourth, for it certainly is a *very* tiring day and they *can't* work as well after it as before, till they are rested. The teacher can resolutely put aside her tiredness, but it is almost impossible for children.

We *thought it was a very interesting* and happy day for us all. Hoping this will meet your purposes to some degree at least, I am,

Yours very sincerely,

(*Signed*) IVA L. ROBERTSON.

FAIRFIELD PLAIN, June 23, 1908.

DEAR MR. LEWIS,—Received your letter, and will be pleased to answer your questions. In the first place I may state that with the exception of one, all my pupils were in their places on the following day. That one, I may add, was a delicate child.

As regards the break in the school work, perhaps the pupils were not so bright as usual on the following day, but I consider this disadvantage was more than made up in the advantages they derived. The pupils I took were in the Second, Third and Fourth classes.

The advantages derived were many, but I shall mention only one or two. The process of sugar making especially struck the second class pupils. I noticed them paying particular attention to the bottles containing the sugar in its various stages, *e.g.*, from the sugar cane to granulated sugar and also the lower grades of sugar. On the following day they asked that we read the lesson on sugar in their reader. We did so and I noticed that all the little excursionists were paying particular attention. Now that lesson on sugar becomes a real live lesson to those pupils, of something they have actually seen for themselves, and not of something away off from us.

The excursion would be a benefit if only for the help the Entrance class derived in seeing the devil fish. In the Fourth Reader is that lesson on the devil fish that is so hard to make the children understand. I myself had never seen the devil fish before and can appreciate the help the Entrance class derived from seeing it. Also the impression of the ferns in the coal were exceedingly helpful. The pupils called my attention several times to view specimens, of which we had been reading the previous week.

The advantages were not confined only to those who went. Only one-fifth of my pupils went, yet the knowledge learned at that experimental farm was conveyed to the remaining four-fifths the following day. At recess, at noon, little groups could be seen, with an excursionist as the centre of attraction. Various were the things being told; how they kept a record of the milk of each cow, how the butter and cheese were made, and the old machinery. The old machinery appealed greatly to the boys. One child told the others that the woodchuck we had in the spring was also called a rodent, and so I could go on.

I cannot say which profited most, as different things appealed to the girls and boys. I think such an outing annually would be of great benefit to the children. We are inclined to keep the children too steadily at books, books, books, and forget that it is by handling and seeing that children most easily learn.

Hoping that this will be of some use to you, believe me,

Sincerely yours,

(Signed) AMY M. ROBERTSON,
Fairfield Plain School.

CONCLUSIONS: This branch of work might readily become a very important factor in introducing agricultural teaching into the schools. If it should develop through the co-operation of Institute workers and school supervis-

tendents, there should always be an attempt made to keep the number of scholars for one instructor small and to have the teachers accompany their classes. The day's instruction will always need to be followed up by the teacher in her daily routine of lessons afterwards, if its best end is to be reached.

The day's experience impressed me strongly with the great use and value of a good museum. I am certain that we have hardly begun to realize this in regard to ours. And at no time in the year could there be so much use made of it as during the June excursion. I have overhauled the Museum this summer and used it with the children and our teachers' classes. The museum is too often and too much non-explanatory of itself; a guide is needed. There might be a part set apart with seating accommodation that could be used for informal talks or lectures at stated hours. To make the collection more comprehenisve the exhibits in the Agricultural museum should be brought over to the main building. There is need too of much re-arranging and relabelling.

Our Plans for Bringing about the Introduction of Agriculture into the Schools.

The problem of bringing about the introduction of agricultural instruction into the schools is a large one and a difficult one. It is a large one in that it concerns such a large part of our population and has to deal with a business that is marked by manifold diversity of the sciences underlying its practice. It is a difficult problem in that the work must be done by a teaching body that has not been trained and which it is difficult to reach.

It is generally felt that the crux of the matter lies with the training of the teacher to carry on the instruction in a practical manner. This is the general plan now being tried where ten years ago it was by means of a text book in the hands of the teacher and pupils. Moreover now we have it an optional subject where a few years ago it was obligatory in school programmes.

We offer below a summary of the plans with a few comments. Further, suggestions for new lines of endeavour are offered for consideration.

1. Our Summer Courses for Teachers.
2. Teachers' Reading Course.
3. Three Months' Course for Teachers in Spring Term.
4. Lectures and Demonstrations at Teachers' Conventions.
5. Visits to the College by Teachers' Associations.
6. Visits of School Children and their Teachers.
7. Correspondence with Teachers and Pupils.

1. *Our Summer Courses for Teachers.* The limitations of this scheme lie mainly in the fact that the teachers in rural schools cannot very well afford the expense. Moreover they are not as a body looking forward to permanent employment in rural schools and do not feel any urgency in equipping themselves for a special line of work that is optional.

The chief value of our summer courses is not in the number of schools that are reached through our students, for that is relatively very small. It is rather in commencing a growth of sentiment amongst teachers in favour of the work.

2. *Teachers' Reading Course.* This scheme has been discussed at length elsewhere. It is hoped that as the interest advances, we may have teachers join it because of the opportunity offered for help towards self-improvement and greater usefulness in their school work.

We have extended the privileges to teachers at their Association meetings. In the meantime they are used chiefly by those who have been in training here.

3. *Three Months' Courses for Teachers in the Spring Term.* This work commences next April with a class of teachers selected from the classes at present in attendance at the Normal Schools. The students will be selected from those members of the Normal classes who have been trained at the Model Schools and had experience in teaching. The plan marks a distinct advance in the attitude of the Government towards the question of industrial training in that the expenses of the students are to be paid. Some provision will be made for securing their services in the rural schools for a term of years. The course of study which will be followed will be that outlined in last year's report.

This scheme has limitations similar to the last mentioned. Only a relatively small proportion of the schools will be reached by it. Its chief value will be in creating a sentiment.

4. *Lectures and Demonstrations at Teachers' Conventions.* During the past year I have attended two Teachers' Conventions. On October 8th I addressed the teachers of North York at Aurora on "Agriculture in the Schools" and outlined plans for them to follow in making a commencement. On November 27th and 28th I joined the Haldimand Teachers in their Convention at Dunnville and gave them practical lessons in (1) seed selection, (2) weed seed identification, and (3) identification of a few common birds. Arrangements were made for an address and practical lessons to the Dufferin County teachers in February, but snow blockades prevented the holding of the convention.

I find an increased interest in Agricultural teaching being shown by the teachers and the inspectors in their meetings. Here and there throughout the Province there are teachers giving their teaching of Nature Study quite a distinct agricultural bearing. Their influence is being felt. In Haldimand County I was particularly impressed by the readiness of the teachers to try suggested experiments.

I believe there are great opportunities for our cause in helping the teachers in their local meetings. They cannot readily come to use. They are pleased to have representatives of the College go to them.

5. *Visits to the College by Teachers' Associations.* During the past year we have been visited by four associations—Berlin and Waterloo, Victoria County, Durham County, Lincoln County—comprising about four hundred teachers. In guiding them about the College, we attempt to point out those things that might find a place in the education of children in country schools.

The chief value of their visits lies in the impression left upon the minds of the teachers regarding the manifold importance of the chief industry of the Province and the provision made for instruction. It may fairly be hoped that there is some realization of an opportunity and a need of the public school sharing in the work.

6. *Visits of School Children and their Teachers.* This scheme has been discussed at length elsewhere. In a limited field it presents good chances for profitable, direct teaching. The teachers accompanying their classes cannot fail to see the reasonableness and naturalness of agricultural teaching.

7. *Correspondence with Teachers and Pupils.* With the organization of the Nature Study Department under the late Dr. Muldrew, this scheme was planned. This relationship with the schools grows closer year by year

The number of applicants for help is gradually increasing. As a rule information is asked about Nature Study matters. Some teachers ask for suggestions for carrying on experiments with plants. Some ask for direction in the selection of text books.

Suggestions for Extending the Teaching of Agriculture into our Schools.

1. By organizing a Public Schools Agricultural Department under the Experimental Union.
2. By a rearrangement of the government apportionment of money for agricultural education through school gardens.
3. By arranging short summer courses for Public School Inspectors.
4. By arranging special summer courses for High School Science teachers.
5. By having College graduates in the Biology, Chemistry and Physics, and Bacteriology options admitted to specialist standing in Science, thus qualifying for High School teaching.

1. *Adaptation of Experimental Union work to the needs of the Public Schools.* For the past four years there has been an increasing number of the Union experiments undertaken by children through the suggestion of teachers. The teachers have been encouraged to make use of the Union for the purpose of introducing the subject of Agriculture into the work of the schools. As the experiments have been carried on in home gardens or fields there was no danger of injuring the reputation of school gardening in case of failure. This work has been done in Horticulture and Agriculture chiefly, but a number of schools have undertaken to care for material sent out by the Forestry Department as well. On the whole the results of this work have been quite satisfactory.

Perhaps the time has come for arranging this branch of the work so that it may be more widely and more easily used. Instead of having it in one hundred schools, we might bring it in a few years to a very large proportion of our rural schools. This may be done by simplifying the work and sending out printed instructions for carrying out the experiments and using them for instructional purposes in the school work. The experiments would be placed in small plots in the school grounds or in a farmer's field immediately adjoining. For each year a select list of simple experiments would be chosen and material for these would be sent to applicants with sheets of instructions. At the end of the season a report would be made to the Committee of the Union having the matter in charge. For example, for the season of 1909 the schools would be given material and instruction for exemplifying the value of seed selection as a topic in Agriculture; in Horticulture they would receive help to exemplify the testing and propagation of two varieties of onions and the cultivation of one flowering plant; in Forestry they would undertake to raise some seedlings for transplanting. In 1910 a different set of experiments would be offered. This work could be carried on in a piece of ground of a comparatively small size—about 20 x 10 feet.

From this might readily grow a tried course of Agriculture for our schools.

2. *Government Apportionments for Agricultural Education.* Should such a scheme as outlined above be taken up by teachers and trustees it might be advisable to change the plans for apportioning grants for school gardens. At the present time trustees are assisted in buying additional land

for a school garden and subsidized by a yearly grant of $20.00 when the school garden is satisfactorily conducted by a certificated teacher. But in the nature of things it will take many years to train a sufficient number of teachers to the required standard, and in the meantime those parts of the country which perhaps need agricultural education most will be no nearer attaining it. By following for *Gardening and Instruction in Agriculture* the splendid system of apportionment that now prevails for buildings, grounds, water supply, equipment, etc., the trustees of our schools would be encouraged to interest themselves in the matter and assist the teachers in developing it. The Gardening and Agricultural Education might be graded I, II, III, IV, in accordance with the size of the garden, the nature of the instruction given in the school, and the care of the plots, etc. If for Grade I $5 were allowed, for Grade II $3.75, for Grade III $2.50, for Grade IV $1.25 or proportionally smaller amounts as the grant permitted the distribution throughout the Province would be equitable and encouraging.

3. *Summer Courses for Inspectors.* In correspondence with the Public School Inspectors through the year, we learned that quite a number favoured the idea of a week's course in July towards the close of our teachers' courses. As the character of the work in the schools is largely determined by their efforts and sympathies it may be readily seen how necessary it is to have their intelligent and united interest in any scheme for the general introduction of Agriculture. Moreover the great majority of them are actively sympathetic in the cause. The need is to have them confer and unite on common plans. A short course which would acquaint them with our plans for preparing teachers, the best plans for arousing interest and the agricultural needs of the Province would no doubt be appreciated and profitable.

4. *Special Summer Courses for High School Science Teachers.* Not the least important plan for bringing Agriculture into the schools lies with the High School Science teachers. It is not overlooked that our Agricultural Specialists are sharing in the High School Science teaching in the specially organized Agricultural Departments recently established. But it is only a relatively small influence which they exert in the science teaching of the Province as a whole, and a very long time must elapse before their influence can be appreciably noticed in the schools. In the meantime Science is being taught in 580 High or Continuation Schools (according to Report for 1907) which have an attendance of 34,707 pupils. When it is realized it is from these schools that the teachers go into the country schools, the wisdom of securing the help of the Science teachers may be seen. And these teachers are in many cases anxious to make the new adjustments for their work. They feel the need of it and the justice of it. One who took a selective course at one of our summer schools writes, "I may say that I have found it very profitable to me. Neither the High Schools of the past nor the Universities of the present time have done anything in preparing teachers for the work which they must undertake with the Nature Study classes. . . . Personally I should like to see some such course instituted for the option of High School teachers. Science teachers from various part of the Province could meet together for a few weeks. And apart from the needful training which they would receive in Nature Study, they would be helped by contact with each other, and by private or open discussions be able to deal more effectively with the other sciences of the school course. They would be welded informally into one body free to consult each other throughout the year, and better fitted to promote or oppose the occasional changes proposed in the syllabus of their work."

5. *O.A.C. Graduates in Biology, etc., as Science Specialists in the High Schools.* At the present time the Education Department of Ontario grants non-professional qualifications for a specialist certificate in science to University graduates in any department of the Natural and Physical Sciences, who having obtained honours in the First, Second and Third Years, were awarded at least second class honors in the Fourth Year provided the candidates have obtained honor standing in the following subjects: Biology, Chemistry, Geology, Mechanics, Mineralogy, Physics (these are selected subjects of different courses). The courses leading to this certificate are (1) Biological and Physical Sciences, (2) Biology, (3) Chemistry and Mineralogy, (4) Geology and Mineralogy.

No good reason can be advanced against admitting the Sciences of Agriculture into this list of courses, and on the other hand good reasons can be urged for bringing the arrangement about. Examination of the different courses of study will show that our students in Biology, Chemistry and Physics and Bacteriology receive an education in science quite equivalent in most respects to that gained at the University. There would need to be some adjustments made in our examinations to suit the requirements of the Education Department possibly, but these could be readily made. And of course the certificates would be restricted to matriculated students.

With representative graduates scattered throughout our High Schools as science teachers a tendency towards an agricultural science teaching would be fostered. It would make its influence felt in the country schools in time through the teachers, and the right time to influence the coming teachers is when they are in the High Schools and not afterwards when they are employed in the schools.

In this same matter, considerable advantage might be secured for agricultural teaching in the High Schools if our fourth year Biology were accepted as an equivalent by Toronto University for its B.A. degree to those students in Honor Biology who might elect to take the applied Biology of our College in their fourth year in anticipation of going into the work of teaching.

Respectfully submitted,

S. B. McCREADY.

PART XXI.

THE DEAN OF RESIDENCE.

To the President of the Ontario Agricultural College.

SIR,—As Dean of the Residence I have the honor to submit my report for the year ending December 31st, 1908. I assumed the duties of my present position on September 1st of this year; hence my report is based in part upon my knowledge of the work of my predecessor, R. R. Graham, B.A., who held office from October 1st, 1907, to August 31st, 1908. From a personal acquaintance with Mr. Graham and with his work, I am in a position to say that his influence upon the general tone of the student body was decidedly elevating, and that the duties devolving upon him were performed most conscientiously and with all due regard for the comfort and general welfare of the students under his charge.

My duties as Dean of the Residence require me to maintain such discipline in the residence as will be most conducive to a wholesome moral tone throughout the student body, and at the same time afford every student an ample opportunity to do the studying which the course and his own ability make necessary. Then, too, in this connection I see that rooms, halls, and all fittings are kept in good repair, and that such a state of cleanliness and tidiness prevails as will at all times render the dormitories comfortable and congenial to study. My duties further require me to preside in the dining hall, and to conduct roll call and prayers. Besides my work as Dean of the Residence, I take the English Composition with the First Year. This involves two lectures a week and the reading of numerous compositions. I found that the majority of the freshmen had on entering this institution, a very limited knowledge of English Grammar and Composition; in other words that they had not the ability to so build words into sentences and sentences into paragraphs, as to effectively communicate their thoughts on familiar subjects. Briefly stated, my mode of procedure in English Composition is to develop in my lectures the rhetorical principles bearing upon the effective use of the English language in speech or in writing. To illustrate and to impress these principles, exercises for class and home work are given, which exercises are carefully examined, errors indicated, and the work returned. A careful record is kept of all exercises handed in by each student.

Now that the new wing, built last year, is open and in use, we have in residence a larger number of young men than ever before. The number at present is 213. About 72 regular students and 6 specialists board out. To accommodate all the regular students who desire to board in, still another addition to the Residence will be necessary. In order to further promote their welfare and to bring about a greater feeling of contentment and satisfaction among the students a complete investigation as to conditions prevailing in the culinary department of the Residence is in progress, with a view to radical changes and thorough re-organization in that department in so far as such are necessary in the interests of the students. Improvements should and doubtless will be made here.

As usual, during the summer vacation, the residence was thoroughly cleaned, walls whitened, floors throughout the building oiled, wainscoting

painted, and repairs made wherever necessary. More beds, bedding, and furniture have been added in the larger rooms in order that the largest number consistent with comfort, might be accommodated. Our accommodation is now taxed to its utmost.

In regard to fire protection, we are now better equipped for that purpose than ever before. On the premises are fourteen hydrants all in good order and ready for instant use. In our fire sheds we have four good reels carrying over half a mile of new, or slightly used hose. The new water tank at an elevation of 125 feet, together with the fire pumps, afford abundant pressure. In convenient places are a number of good ladders. Within the buildings are small chemical fire extinguishers. The main building is equipped with fire escapes which are in good order. Shortly after assuming my duties it occurred to me that while something had been done in the way of fire protection, much yet remained to be done before we could consider ourselves adequately protected. The value of our property and the large number of human lives in the main building made the matter seem to me one of great importance. I secured the services of the Chief of the Guelph Fire Brigade, talked the matter over in student meetings and finally organized a brigade of 36 men. Our first drill was under the direction of the City Chief. Since then we have had numerous drills under my own direction. At the present time we have a very fair supply of apparatus, water pressure sufficient for any fire, and a brigade of trained and willing men.

In conclusion, permit me to say that the same sense of honor, loyalty and gentlemanliness which has always characterized the student body, prevails unabated to-day. I am on the whole greatly pleased with the general good behavior of our students and with the industry which they have manifested in the pursuit of their studies. It is a matter of great satisfaction to me to feel that I have the co-operation of the student body in my endeavors to enforce such rules and regulations as are necessary in connection with life in the Residence. I have endeavored to deal fairly with all and to be reasonable in everything.

Respectfully submitted,

GEO. M. FRIER.

PART XXII.

THE LIBRARIAN.

To the President of the Ontario Agricultural College:

Sir,—I have the honour to submit herewith the report of the Library for the year 1908.

During the past year 1,030 volumes have been added to the Library; 165 of which have been magazines, reports and bulletins that were bound, and classified as follows:

Agriculture	45	Forestry	2
Agricultural reports	89	Geology	14
Apiculture	9	History	53
Bacteriology	12	Horticulture	32
Biography	24	Horticulture reports	10
Botany	34	Hygiene	23
Chemistry	44	Literature and composition	164
Dairy	22	Manual training	4
Description and travel	7	Mathematics	6
Domestic animals	50	Meteorology	5
Domestic science	35	Nature study	3
Drawing and decoration	12	Ornithology	1
Economics	31	Physics	7
Education	26	Psychology	16
Engineering and electricity	26	Reference and general magazines	93
Entomology	6	Science	16
Ethics and religion	32	Science reports	12
Fiction	32	Useful arts	6
Fine arts	9	Zoology	6

The reference sets which have been added are:

Encyclopedia Americana, 16 v.

Garnet, R. and others, Universal anthology of literature, 33 v.

Cyclopedia of architecture, carpentry and building, 10 v.

Lord, John, Beacon lights of history, 15 v.

World's work, 1900 to date.

We wish to take this opportunity of expressing our appreciation of all ur exchanges, especially those of the United States Department of Agriulture, the Experiment Stations of America, Australia, Cape Colony, apan, India, South America and Europe.

In the work of recataloguing the Library we have been able to do nearly 00 books; that is, all the books on horticulture, and many on English literture including all the books on Shakespeare and Tennyson. Besides these e have recatalogued the bulletins and reports of the United States Departent of Agriculture, the Experiment Stations of the United States and ther countries, and the magazines of which bound files are kept.

The periodicals bound during the year have been 188 in number, while 1 books have been rebound.

The circulation of books which have been given out to students for use over night has been 4,905 during the past year. No account can be kept of the books, magazine articles, bulletins, etc., which are used in the reading room only; and as this forms a very large part of the library work, the circulation figures can show only approximately how much the Library is used.

The period of the largest circulation was during the winter term when from January 1st to April 15th 2,413 books were given out.

EDITH C. DWIGHT,

Librarian.

PART XXIII.

THE PHYSICIAN.

To the President of the Ontario Agricultural College:

SIR,—I have the honour of presenting to you my report for the current year.

It will scarcely be necessary for me to give details of the many slight ailments or injuries which have come under my care during the year. They have been very numerous and there have been a large number of serious cases also. The winter months passed by with about the average sickness incident to that time of the year. Nothing out of the usual occurred except an outbreak of Rötheln, which spread widely amongst the students of the College and the Hall. No one was very ill with it and I need not make any special reference to any other cases, beyond stating that we were obliged to send a number of our patients to the city hospitals or employ a trained nurse for them.

The Autumn term opened with a large increase in the attendance. The weather was very fine and favourable to out-of-door life and to the maintenance of health. So there has been no sickness out of the ordinary thus far this term, until within the last fortnight or so. A few minor accidents have occurred and one case of varicella. At the present time we have also one case of typhoid fever in St. Joseph's Hospital, and the patient is very ill.

At the opening of the College term I was called on, as in other years, to vaccinate a large number of students. Owing to their time being fully occupied from the day of their arrival and to objections on the part of some, it is difficult to get this important duty done. In my opinion it should be rigidly required before admission and so announced in the calendars.

On account of the largely increased attendance the bathing facilities seem to be unequal to the demands made upon them, and an increase in the accommodation in this respect has become necessary, especially, I should say, in the number of shower-baths, which, in my judgment, should be doubled.

The general sanitary conditions of the College and Hall are excellent.

W. O. STEWART.

Guelph, December 2, 1908.

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